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The CTARP Energy Facility Siting Study

Vol. II: Impact Analysis and Case Studies

Washington, D.C.
April 1979

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Coastal Zone Management

The CTARP Energy Facility Siting Study

Vol. II: Impact Analysis and Case Studies

Prepared for the Office of Coastal Zone Management

by

The Center for Technology Assessment and Resource
Policy/Department of Engineering - Economic
Systems/Stanford University/Stanford, California 94305

Washington, D.C.
April 1979

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The CTARP energy facility siting study.

The Center for Technology Assessment and Resource
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Part one.
Impact analysis.

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I. ANALYSIS AND DECISION-MAKING.

Buying groceries is easy.

A typical consumer has little difficulty discerning within seconds whether a vegetable is fresh, or predicting, with equal alacrity, how the vegetable will perform in a casserole. And, with only a little more effort, the consumer can evaluate whether this particular eggplant is worth the price the supermarket is asking.

Evaluating the siting of an energy facility is not nearly so simple a task. This is so for two reasons.

- An energy facility is more complex; the effects of siting (or failing to site) a facility are numerous, uncertain, and not easily understood without study.
- There is no single individual -- no "philosopher - king" -- who decides whether the beneficial aspects of siting the facility are worth the costs (in the way the consumer decides whether the benefits of an eggplant are worth the price charged).

The job of the analyst is to deal with the complexity of an energy facility siting decision -- to analyze and predict the effects (or "impacts" as they are known in governmental argot) of siting and to render the analysis into a form that will allow those involved in the decision-making process to make the necessary value judgments effectively.

Chapter I of this part discusses the business of analyzing the effects of energy facility siting. It sets forth a conceptual framework for and philosophy of analysis, establishing criteria for "good analysis." The first chapter also discusses some of the problems of analysis within a strategic context, and discusses the role of analysis in a multi-party decision process.

Chapter II brings the philosophical discussion down to earth by presenting a demonstration of the techniques advocated in Chapter I. Specifically, the demonstration analyzes the proposed Outer Continental Shelf (OCS) lease sale #48, off the shore of southern California, and discusses what each of the major participants in the controversy surrounding the lease sale stands to gain or lose. While not intended to be definitive -- and, indeed, intended mainly as a demonstration of analytic approach -- chapter II is quite detailed and is intended for the technically oriented reader.

A. Introduction to Impacts.

In its simplest form, an energy facility siting decision has three parts, as indicated in Figure I.A.1. There is the choice, the effects of that choice (measured in appropriate units), and the values assigned to those effects. The underlying concept is that the effects of an energy facility siting decision should be separate, in the minds of those analyzing and making the decision, from the values one attaches to those effects. If this distinction is clear, then discussion can center on the values (how much is a given amount of environmental damage worth *versus* a specified increase in, say, local employment?), not on the effects themselves. In theory, the effects of a siting decision can be determined, or at least placed within bounds, on something approaching an objective basis; at the very least, a controversy over the effects of the decision should be separated from a controversy over values.

The three options -- permit siting, reject siting, or permit siting with conditions -- are really a simplified representation of a range of options. There are always possibilities intermediate between unqualified acceptance and outright rejection of a siting proposal; these include delay of acceptance and any number of permit qualifications. (Indeed, of eight major energy-related permit applications considered under the terms of California's Proposition 20, which paved the way for coastal management in that state, only one was denied; the others were accepted with conditions [1].) In practice, of course, one would set forth explicitly each possible permit condition as an option.

Figure I.A.1 depicts the outcome of each siting option as a set of specific effects, labelled e_1 through e_n, etc.

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[1] U.S. Department of Commerce, *State of California Coastal Management Program and Final Environmental Impact Statement*, p. 159.

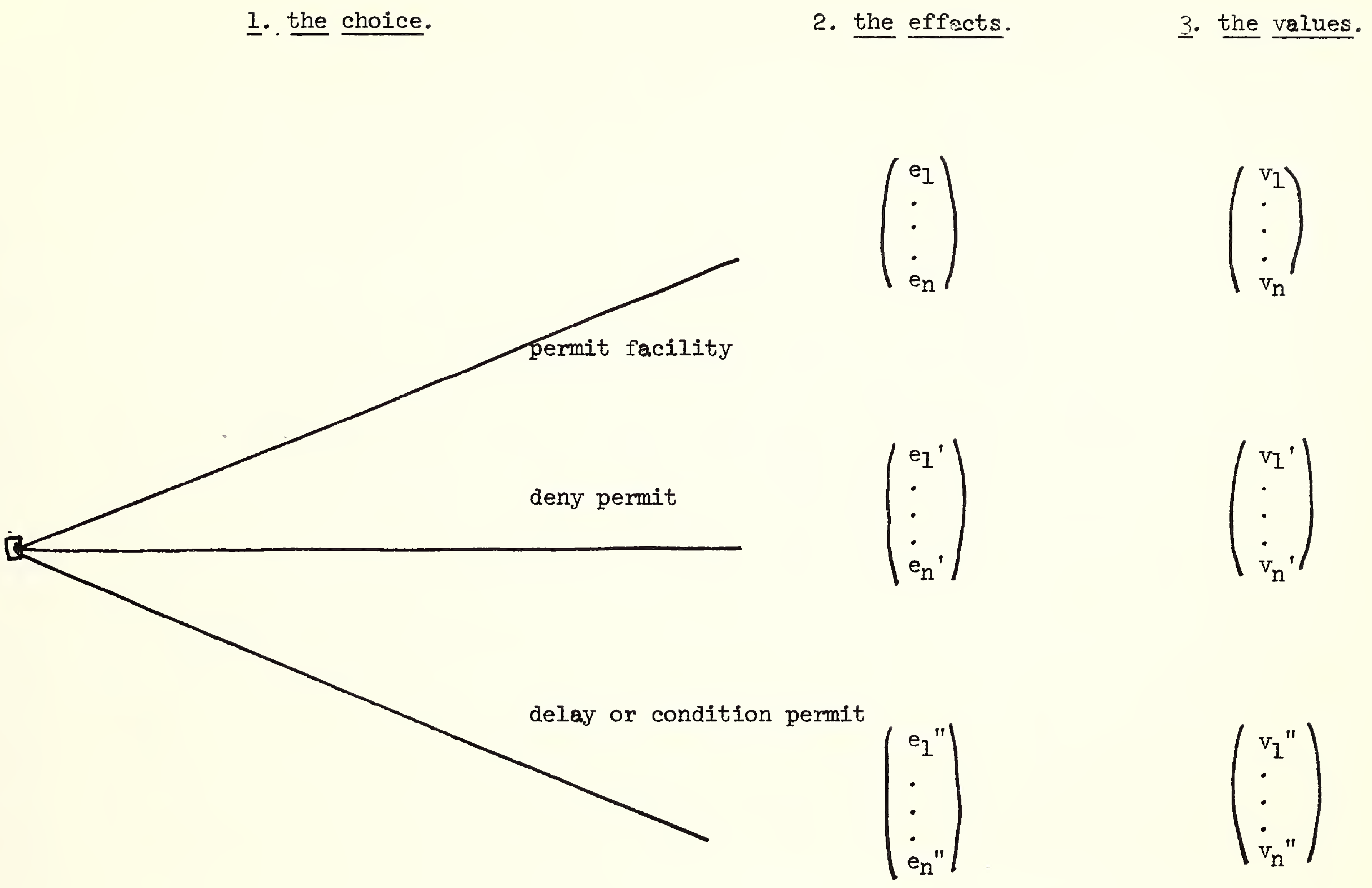

Figure I.A.1

The Energy Facility Siting Decision

The first element of this set might be the market-economic effects of a given choice of siting options; the second element might be the environmental consequences; and so on. Each effect is measured in appropriate units -- dollars for the market effects, acres of wetlands lost for the environmental effects, etc. The value of these effects -- the tradeoff rates between dollars and wetlands or dollars and persons employed (or even wetlands and persons employed) -- is a different matter.

This section takes a quick look at the types of effects that might result from an energy facility siting decision, along with some indication as to how one might go about detecting and measuring these effects. The problem of valuing effects is discussed in the context of comparing market and non-market effects as distributed among concerned parties.

1. The Direct Economic Effects of Siting an Energy Facility

The siting of an energy facility is an addition not only to the energy system but to the economic system as well. Economic analysis provides a way of judging whether a potential change in the economic system is a beneficial change (from an economic point of view) and of assessing the amount of benefit or loss that can be attached to the change.

The mere mention of such methods is generally sufficient to call forth a litany of their deficiencies. Surplus analyses, and cost/benefit analyses more generally, do have very serious shortcomings; but these shortcomings manifest themselves primarily when the techniques are badly or injudiciously applied. Taken in proper perspective, an economic surplus analysis has a good deal to teach a decision-maker.

Rather than intoning caveats and engaging in economic apologetics (or even very rigorous economic analysis), this section will merely sketch out the general approach to assessing the purely market-economic effects of siting an energy facility.

The question one must ask is, "What is the benefit, in purely market-economic terms, of adding a new energy facility to the national economic system?" Why, in short, is it good, and how good is it, to have a new energy facility? Journalists and public officials talk about "badly needed energy supplies"; but what does this mean in economic terms?

One approach to measuring the benefits to society of an investment project is surplus analysis [2]. Suppose the market for a particular commodity can be represented at some fixed time by the supply and demand curves of Figure I.A.2. The market clearing price is p, and, at that price, consumers buy an amount of the commodity q. The cost to all consumers -- in terms of resources consumed and rents paid to factors of production -- for this quantity is pq, or the shaded areas B plus C. The demand curve is really a marginal "willingness-to-pay" curve, so the implied value to consumers of quantity q at price p (in "willingness-to-pay terms") is the integral of the demand curve out to point q. This integral is the total shaded area in Figure I.A.2. Subtracting out cost to consumers, areas B and C, leaves a "surplus" to consumers of the shaded area A. The surplus is a measure, in this theory, of the benefit to consumers in this market.

Similarly, the supply curve in Figure I.A.2 can be interpreted as the producers' "willingness-to-supply" curve [3] The difference between the amount at which a producer would be willing to supply a unit of production and the amount he actually receives for the unit is called "producers' surplus."

---

[2] For a less terse introduction, see, e.g., Samuelson, P., Economics, McGraw-Hill, New York, Ninth Edition, 1973, p. 436; and for a thorough presentation, see Mishan, E.J., Cost-Benefit Analysis, Praeger Publishers, New York, 1976.

[3] The supply curve includes a normal return to investment as part of the cost, since without at least a "normal" return, the producer would not be willing to supply, but would invest elsewhere.

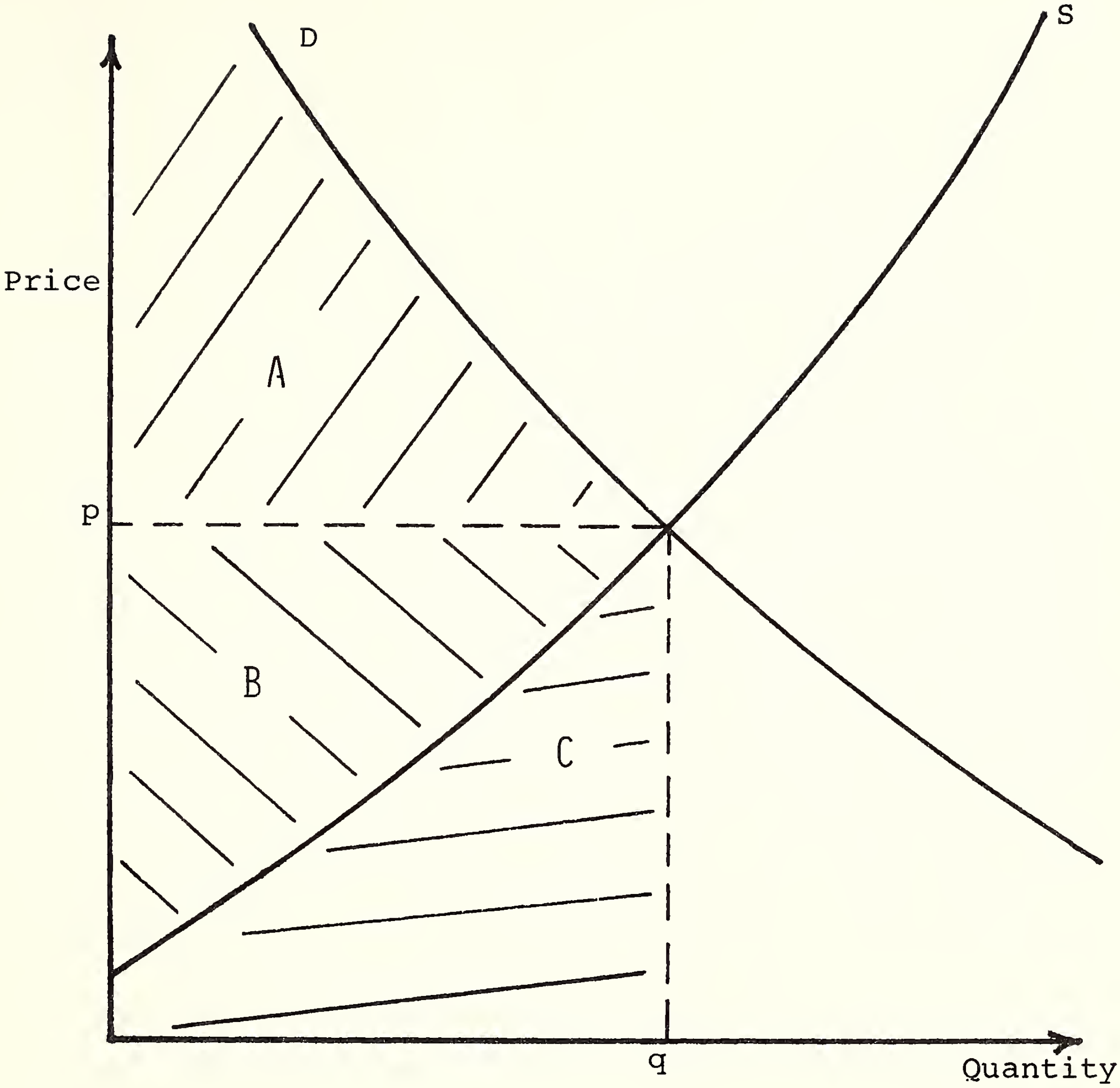

Figure I.A.2

Producers', Consumers', and Social Surplus

And, in analogy with consumers' surplus, the producers' surplus in Figure I.A.2 is the shaded area B, which lies above the supply curve S. The area C is the actual cost of producing the amount q.

The net sum of consumers' and producers' surplus, areas A plus B, is the "social surplus" in the market.

When assessing a capital investment like an energy supply project or facility, one is interested in the change in surplus in the market. The effect of such a project is that it shifts the supply curve in some manner -- it increases supply and/or lowers the cost of supplying the good [4]. Suppose that an energy supply project is economically feasible when the price of its product is greater than p. If the project is permitted, it will affect the market as depicted in Figure I.A.3. As the supply curve shifts to S', consumers' surplus increases by the shaded area A plus B because of the lower market-clearing price p' and by the shaded triangle C because of the increased supply q'. Area ABC, then, is the added consumers' surplus the investment project will generate. Since the price of the good is now lower, producers' surplus is decreased by the shaded area A; but, because the supply curve has shifted to the right and down, and production has increased from q to q', producers' surplus has also increased by the area D. In effect, the amount A has been transferred from producers to consumers. The net increase in social surplus, then, is the area BCD. This increase in market valued social surplus must be balanced against the other positive and negative effects induced by the facility which are not valued by the market.

---

[4] The shift in the supply curve might be called the "effect" of the investment in market terms, while the social surplus is the "value" of that effect.

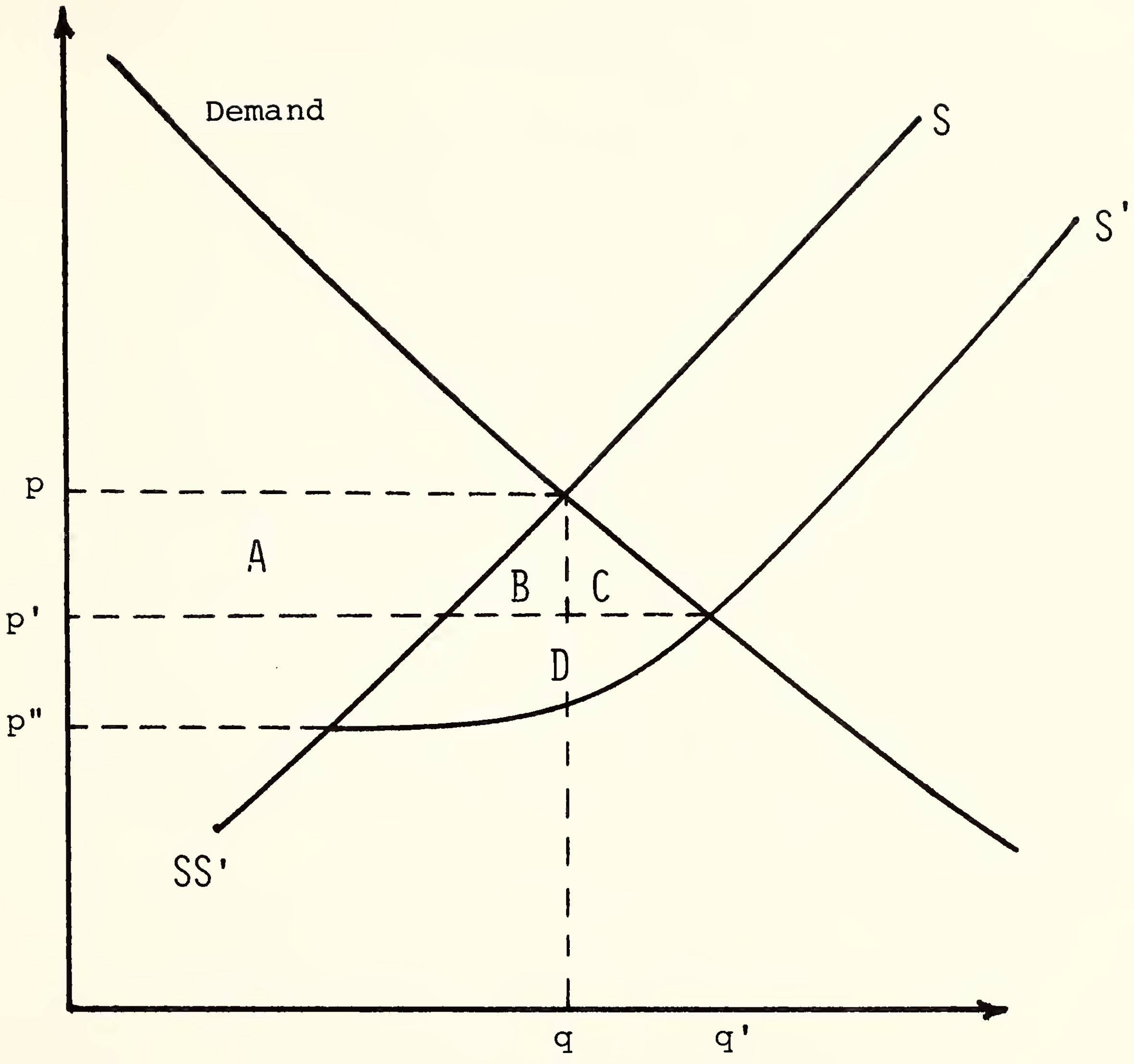

Figure I.A.3

Changes in Social Surplus

2. The Indirect Effects of Siting an Energy Facility

There are other effects of an energy facility siting decision that cannot be so directly measured and valued within a market framework. These effects are "externalities," effects external to the market.

In simplest terms, an externality is a "spillover" effect: the costs (or benefits) imposed by an economic agent on other economic agents without the former bearing the costs (or sharing the rewards) of that imposition through normal market channels. The siting of a large energy facility on the coast, for example, might affect the ecology of an area, might create a safety hazard to nearby populations, or might cause socio-economic disruptions of the local communities supporting the facility's construction or operation; these would be external costs (negative externalities). On the other hand, the siting of such a facility might increase local employment, might reduce local taxes, or, on a larger scale, might generate strategic or embargo-insurance benefits to the country as a whole by reducing imports; these would be external benefits (positive externalities).

Effects that are external to the market often cannot be valued (priced) in the same manner as market goods.

This does not mean, however, that these effects can be ignored in making energy facility siting or similar decisions; indeed, it is precisely because of these external effects that such decisions are made increasingly in the public sector.

While few would debate the necessity of considering external effects, many analysts and decision-makers balk at the idea of valuing these external effects explicitly. External effects -- particularly those of an environmental sort -- are frequently viewed as "non-quantifiables" that simply cannot be compared with other effects. This view results in a tendency to analyze siting (or similar) decisions strictly according to effects, with no attempt to indicate how a unit of one effect could be valued in terms of a unit of some other effect.

In many instances it is a sound approach merely to state the effects, in appropriate units, and to let the decision-maker apply his values to the effects. But one can often go beyond this; and, to the extent that an analyst can put the value of various effects in perspective for the decision-maker, he should do so.

While it may not make sense to calculate a priori a dollar value for certain types of environmental effects (e.g., \$3 for each fish lost and \$24 for each seabird destroyed), it does make perfect sense to assert that the effects of a siting decision are in fact comparable. Ultimately, a decision will be made; and the choice taken in that decision contains an implicit comparison -- an implicit relative valuing -- of the effects of that choice.

A simple example: imagine an energy facility that, if constructed, would result in an economic benefit of \$1 billion to the nation. Unfortunately, this facility, even if constructed in the most environmentally sound manner possible, will destroy the last known habitat of some endangered species. If there are no other significant effects anticipated from the construction of this facility, then a decision-maker who denies a permit to build the plant is implicitly valuing the endangered species at more than \$1 billion.

A failure to make these implicit values explicit is perhaps as great a disservice as a glib and inappropriate assignment of dollar values to external effects.

Since the decision-maker must compare effects, the analyst should try to approximate, or at least place within bounds, the values of as many effects as possible. And there are often ways to do this.

a. Reduced Oil Imports

The market-economic benefits of domestic oil production can be evaluated using the techniques described earlier. But there may also be reasons external to the market for wishing to produce oil domestically, for wanting to be less dependent on foreign oil. There are three areas in which to look for external benefits of substituting a barrel of domestic oil for a barrel of imported oil.

- "insurance premium" benefits related to the possibility of an embargo or rapid price rises,
- balance of trade benefits, and
- international relations concerns.

"Insurance" benefits. Since each barrel of domestic oil (or other domestic energy) can be thought of as substituting for a barrel of foreign oil, and therefore as reducing slightly the damage wreaked on the country by an embargo or rapid price rise, an energy facility or energy supply project is like a small insurance policy. The maximum per-barrel premium one would want to pay for that insurance is equal to the benefit from having the facility in case of embargo or price rise times the probability that the embargo or price rise will occur in the next year (insurance premiums are normally calculated on a yearly basis).

Balance of trade. In principle, it might be in the country's interest to reduce its trade deficit -- caused in part by imports of oil -- by substituting more domestic energy, even if that domestic energy were slightly more expensive. The question one must ask is, "how much should the country be willing to pay to produce domestically something it could import for $1?" For example, an answer of $1.05 would imply a premium value of five cents per barrel on domestic energy.

International relations. This is the fuzziest of the three areas in which to seek external benefits to reduced consumption of imports. But a federal policy-maker in, say, the State Department might see a benefit to the country, in terms of the nation's foreign policy goals, to reducing imports. Such a policy-maker might then be asked to ascribe a per-barrel premium to that reduction. (In fact, the premium could be negative if he views our financial interrelationship with the Arab nations as a benefit -- for reasons of Mideast stability, perhaps.)

There is a caveat attached to this sort of analysis, though. If one believes there is a premium, for the reasons cited above, to the reduction by one barrel of imported oil consumption, then the true cost to society of imported oil is higher than the price charged for that oil. From this perspective, there are a number of policies, including a tax on foreign oil equal to this imputed premium, that could more cheaply effect the same benefits as building the proposed facility. But an analyst faced with evaluating a specific proposed facility is not often very helpful if he asks these larger energy policy questions. With a specific set of federal energy policies in operation, the marginal analysis described above is appropriate. The costs of decision-making rise dramatically if broad policies are re-evaluated with every facility siting controversy.

b. Environmental Change

Environmental effects (or, in some cases, ecological effects) are in most ways the hardest to value. Once again, though, the question of value becomes slightly more tractable when removed from the *a priori* realm.

In general, the nature of the effect itself suggests the most appropriate way to approximate (or bound) its value. The range of techniques is broad; the following are merely an illustration, not a catalogue.

Example 1: *Existing markets*. Occasionally, things of ecological value also have a market value. Seafood is perhaps the best example: if an energy facility reduces seafood production, the loss can easily be evaluated at the market price of the seafood. (This also holds true for an *increase* in production attendant on the siting of a facility -- increased fish catch around an offshore oil platform, for example.) One can argue that the fish or shellfish have an ecological value in addition to this market value; but the market value is, at the very least, a lower bound.

Example 2: *Cleanup cost*. When the siting of an energy facility has as an incidental effect the production of environmental pollution, then the valuation of the effect at the cleanup cost is often appropriate. For example, if offshore activity might cause an oil spill, the expected value of the cost to clean the oil off the affected beaches might be an appropriate value. If the damage cannot be corrected completely, or if there is some residual ecological loss or change, the problem becomes harder. But, here again, the cleanup cost is a lower bound that puts the value of the effect in perspective. This technique might be appropriate for air and water quality (pollution) effects in general when those effects are primarily non-ecological.

Example 3: Correction costs. In some cases, the concept of a "cleanup cost" can be extended into a more ecological domain when there are ways of correcting the ecological damage. Examples would include revegetation of a marsh, reseeding a shellfish bed, or restocking a fish or wildlife species. Again, to the extent the correction is not complete, the cost estimated in this way is only a lower bound to the value of the ecological effect.

Example 4: Health effects. In some cases, notably that of air pollution from a proposed energy facility, the cost of the pollution effect can be approximated in terms of the increase in health damage inflicted on the population. This involves estimating the pollutants likely from the facility, the dispersion of those pollutants around nearby populations, and the attendant increase in health damage. This does not resolve the problem of evaluating the health damage; but there are approaches to that problem as well. The demonstration analysis in Chapter II illustrates this technique in detail.

These examples provide a sense of the way in which one can occasionally approach the valuation of environmental effects. Since the intention is to place these effects in a value-context for the decision-maker, and not to set values *a priori*, it is often useful to attack the valuation problem in several ways. But, ultimately, the tradeoffs among effects must be made by the decision-maker; and, in some cases, little more than that can be said about environmental effects.

There is one final idea that should be discussed briefly before leaving the topic of environmental effects. This is what one might call the "endangered species" problem. To put it simply, there may be good reason for a decision-maker to attach a higher value to the destruction of the last remaining members of an important species than to the destruction of a similar number of more abundant flora or fauna. (The obverse side of this notion is that one shouldn't value a marginal plant, animal, or marsh as if it were all such plants, animals, or marshes; that is, while it may be extremely important to preserve marshland, it may or may not be so important to preserve any particular marsh.)

c. Safety

The valuation of public safety effects is at once easier and more difficult than the valuation of environmental effects.

The valuation is easier to the extent that it involves private property, which has a clear market value. It is more difficult to the extent that it involves the loss of human life, the valuation of which remains a controversial and emotional issue in most circles.

Safety is an issue associated almost exclusively with nuclear power plants and liquefied natural gas (LNG) facilities. Indeed, in the former case, the safety issue overshadows all others. The issue is hotly, and often irrationally, debated in both cases. In concept, though, the analysis is straightforward [5].

The effects of possible accidents are generally described in terms of catastrophic scenarios. One can estimate the value of property destroyed and the number of lives lost in each scenario, then ascribe probabilities, in suitable fashion, to these various scenarios. This creates a probability distribution over the potential losses, which can be summarized by the expected value of property lost and the expected number of lives lost [6].

There are a number of ways to think about the valuation of human life [7], and they should be discussed in any safety analysis of this sort. Nevertheless, the idea of valuing a human life is so controversial that it is frequently politic not to place a heavy emphasis on the quantification of this effect.

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[5] For an example of this sort of risk analysis, see Ted Dinterman, "The Safety of Liquefied Natural Gas Transportation," in Alternatives for Alaskan Natural Gas, Center for Technology Assessment and Resource Policy, Stanford University, July, 1976.

[6] The shape of the probability distribution is also important, though: it makes a difference that an expected destruction of $15,000 worth of property arises from a 1/1000 chance of $15 million damage rather than a 50-50 chance of $30,000 damage. See the review of uncertainty and risk in volume 3 of The CTARP Energy Facility Siting Study.

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[7] See, e.g., Ronald A. Howard, "Social Decision Analysis," in Readings in Decision Analysis, Stanford Research Institute, Second Edition, 1976, p. 199.

d. Land Use Changes

The advent of an energy facility will frequently change the pattern of development and the use of land in its vicinity. These changes many times alter the complexion of the local community -- creating, in extreme cases, the sort of socioeconomic disruption discussed below.

One can argue persuasively that, in the long run, people choose a community according to their preferences in, among other things, land-use patterns and related amenities. It thus follows that a change in the land-use patterns of a community will tend to make some residents worse off. Changes in land-use arising from the siting of an energy facility should thus be a consideration in analyzing a siting decision.

There are, however, some cautions.

People who change their residential or land-use patterns in response to the construction of an energy facility often do so freely to take advantage of the external economies created by the facility (e.g., an easier commute to work, more people to sell goods to, etc.). While these changes may make the established residents of the community less well off in some sense, the changes may involve no overall resource costs. That is to say, land-use effects are generally a distributional concern; they alter the distribution of costs and benefits to the region or the country as a whole.

Furthermore, land-use changes create adverse effects primarily in the short run. As argued above, people who do not enjoy living in a post-energy facility community will ultimately leave, while others who find the surroundings more pleasant will move in.

e. Local Economic Effects

As noted above, changes in the structure of a community as a result of the siting of an energy facility can reduce the welfare of some local residents. But the siting can also increase the welfare of some residents. The construction and operation of an energy facility requires the hiring of local workers (to an extent that depends on the type of facility) and the purchase of materials from local suppliers (both by the facility itself and by the workers who construct and operate it). Since the welfare of the local residents depends on their incomes and whether or not they are employed, the advent of an energy facility clearly can have benefits to the local community.

An analysis of the local income and employment effects begins with estimates (normally from the companies proposing the facility) of the expected construction and operation workforce and of the local expenditures likely to be made by the facility. The analysis proceeds, in its simplest form, using multipliers to gauge the "ripple" effects of these new workers and these new expenditures in the local economy [8].

Finally, the advent of a facility may also have an effect on the fiscal balance of the local community. In many cases, the effect will be entirely salutary, as the facility and its workers swell the tax roles. Occasionally, though -- and these cases are discussed below -- the cost to the locality of providing new public support facilities and services will outweigh the new taxes collected.

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[8] The classic technical reference in this area is W. Isard, Methods of Regional Analysis, MIT Press, Cambridge, 1960. Also, the federal government has sponsored numerous studies and workshops to educate state and local planners in the methodology of this sort of analysis.

f. Socioeconomic Change

When a community is called upon to support the construction and operation of an energy facility, there may often be positive employment and income effects to the community. In some cases, though, these effects can be too much of a good thing.

When a large energy facility, requiring thousands of construction and operating workers, is sited near a small, isolated community, the facility can literally overpower the community. These towns experience a "boom town" effect in which housing and public infrastructure and services for these workers lag far behind the need. This situation exacerbates social problems in the community (e.g., alcoholism, disaffection, marital breakup) which, in addition to reducing dramatically the welfare of both established and new residents of the community, contributes to lowered worker productivity. This means that a larger number of workers are needed to build and run the facility -- which in turn worsens the shortage of community services.

These effects, as listed above, are most severe for small communities that are not within commuting distance of larger service centers. If a facility were to be located near a large city, by contrast, no such socioeconomic disruptions would likely occur.

Socioeconomic effects such as increased drug abuse or the destruction of traditional community values are difficult to quantify. But again as a lower bound, one can calculate the cost of helping to prevent these effects by providing additional schools, hospitals, housing, counseling centers, etc., in time to prevent inadequate support services for the facility's workers. This can be calculated by estimating the number of new residents the community will be faced with (including residents "induced" by -- who come in to support -- the facility's workers) and then multiplying this figure by a per capita cost of providing new public facilities and services (generally on the order of $5,000 to $7,000). Of course, more sophisticated modeling of the prevention cost is also possible.

3. The Distribution of Effects.

The preceding analysis has treated effects and values in a fairly general way. The underlying framework is clearly that of a cost/benefit or tradeoff analysis, although the paradigm has been recast slightly to make explicit the distinction between effects and values as well as the distinction market effects and external effects.

In order to approach the issue of "the national interest" (or indeed of anyone's interest in a proposed facility), one must begin to superimpose some additional structure on this general framework. The first and most obvious need is to examine the distribution of the effects of an energy facility siting decision [9].

Each set of effects (of the types discussed above) can be disaggregated to a set of effects for each region of interest. The same can be done for the set of values attached to the effects. In other words, each region of interest will feel the effects of an energy facility siting option differently and will value those effects differently. Since controversies over the siting of a facility generally center on the differential incidence of effects -- not on the overall sum of costs and benefits -- this disaggregated structure is an obvious necessity.

Examining the effects described above from this regional perspective, one can see that, although all effects will be felt both locally and nationally, some effects will have a negligible local impact (e.g., the overall benefits of increased energy supply), other effects will be small from a national point of view (e.g., local employment or land-use effects), while still other effects will have both local and national significance (e.g., the potential destruction of valuable coastal environment or amenities).

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[9] For present purposes, the discussion centers on the distribution of effects among regions. Another concern is the distribution of effects among income groups -- the income transfer implications of energy facility siting. An analysis of that aspect of the problem is, unhappily, beyond the already large scope of this Study.

The most appropriate regionalization (whether to look only "nationally" and "locally" or to include state-wide, regional, or multi-local perspectives) will depend, of course, on the specifics of the siting questions under examination. If one is considering "the national interest," the effects of the decision should be regionalized at least to a level of "national" versus "state/local." If one is considering the "uses of regional benefit" issue [10], the appropriate disaggregation might be "local" versus "state-wide."

In principle, the magnitude and distribution of effects should be evaluated on a facility-by-facility basis. But a typical breakdown might be as follows.

- The market-economic costs and benefits of a facility can be large nationally -- quite often in the billions of dollars -- but the effects are felt only weakly by any one individual or small group of individuals. Thus, the market-economic (social surplus) benefits of a facility are probably always negligible from a local point of view (though not necessarily from a state-wide point of view).
- Environmental effects are perhaps the most likely sort of effects to be felt strongly both nationally and locally. While it is true that the loss of an environmental amenity strikes most heavily at those living nearby, the "magnitude" of this effect

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[10] CZMA, section 306(e)(2).

depends critically on the values assigned to it, and one can conceive of a situation in which the nation as a whole -- speaking, perhaps, through federal environmental legislation -- values an environmental resource more highly than does the local citizenry.

- Destruction of person and property resulting from an energy facility is a cost to the nation as a whole in the same sense as the steel used in building the facility is a cost. But, since the destruction is obviously local, safety considerations are relatively larger effect from the local point of view.
- Land-use effects are almost exclusively of local concern. Indeed, from a classical cost/benefit analysis standpoint, these effects should not be considered as costs to the nation since they do not involve the allocation of scarce resources. This is an unnecessarily narrow approach for present purposes: land-use changes clearly do have a significant effect in a welfare sense. In any case, though, these effects are significant locally but negligible on a larger scale.
- Employment, income, and local fiscal balance effects are also frequently not considered in national cost/benefit analyses. Here again, these effects are important locally and often figure heavily in siting decisions. From a purely national point of view, though, the effects aren't significant.
- Socioeconomic effects do involve resource costs to the nation, if only because the "boom-town" effects associated with the most severe socioeconomic disruptions can lower the productivity of the

labor involved in building the facility. Here again, the effects loom far larger locally than nationally.

- While reduced dependence on foreign oil benefits everyone, it is an externality in the nature of a public good -- which for present purposes, means that the benefit to any individual or small group of individuals taken separately is slight, even though the overall value may be high.

Table I.A.1. summarizes this discussion.

It is interesting to note that those effects likely to seem most significant from a national point of view are likely to seem least significant from a local viewpoint; and those that seem important locally are likely to appear least important nationally. This dichotomy is in many ways a critical force underlying energy facility siting controversies.

Effects	National	State/Local
Direct Economic	Significant	Negligible
Reduced Oil Imports	Significant	Negligible
Environmental	Significant	Significant
Safety	Possibly Significant	Significant
Land-Use	Negligible	Significant
Local Economic	Negligible	Significant
Socioeconomic	Negligible	Significant

Table I.A.1

The Distribution of Energy Facility Effects

B. The Philosophy of Analysis

There is a fundamental distinction one must make, in discussing "analysis," between analysis as explanation and analysis as a basis for action. The former is scientific inquiry, the result of which is a better understanding of the phenomenon being studied. The criterion for "good" analysis in this case is the ability of the analysis to explain; and this explanatory power is viewed to a large degree without reference to cost or time limitations. The scientific method does, however, impose on the scientist a discipline to govern his modeling and data gathering.

Energy facility siting, though, is not primarily a scientific problem; it is an economic -- i.e., a resource allocation -- problem. As this chapter has repeatedly pointed out, a proposal to undertake an energy facility project implies an inevitable decision: one way or another an action will be taken. And such a decision has imperatives that impose a discipline on the analyst in a way different from but analogous to the scientific method.

Problems in the analysis of siting decisions are principally failures to understand and represent in a useful manner the objective (or quasi-objective) effects of siting options. In general, these problems arise not from a lack of sophisticated techniques but from a lack of needed concepts -- a lack of sound organization and philosophy.

The "subjective" problems with analysis involve a general unwillingness to confront the tradeoffs implicit in any decision and an unwillingness to express the subjective -- the political -- value judgments of decision-making.

This section discusses some of the analytical concepts (along with the complementary misconceptions) important to understanding and presenting the nature and distribution of facility siting effects in an effective and useful manner for decision-making. The next section looks at the subjective aspect of decision-making, and discusses the pressures a political context places on an analysis.

Most if not all problems prevalent in analyses of energy facility siting decisions can be traced to a single source: the failure to treat the problem as a decision.

Because the siting of an energy facility entails a complex set of effects (of the sort detailed in the preceding section), an analysis of the decision requires modeling. Modeling is nothing more than the abstraction and simplification of complex reality into a form that is understandable and useful to human beings. In many cases, this modeling can itself become complicated, detailed, and highly mathematical; there is no lack of sophisticated techniques for application to the representation and measurement of energy facility siting impacts.

But without a focus on a specific decision, this modeling loses, in effect, its sense of purpose. There is then no basis on which to identify critical factors in the analysis, no way to infuse the analysis with a sense of proportion and emphasis. Specifically, this lack of focus leads to over-modeling and under-modeling -- often in the same analysis.

At a glance at chapter II will quickly disclose, the "model" in an analysis is really a set -- a chain -- of models. The analyst must have criteria on which to decide how much effort he should expend on each link in the chain; all too frequently the criteria employed include convenience, personal interest, and -- perhaps most often -- political pressure and strategic concerns.

But there is another, more rational, criterion one could use: a criterion of "equal marginal improvement." The questions a modeler should ask are of the following sort: How much will an additional unit of effort on this link in the modeling chain contribute to an understanding of the decision at hand? Will a similar unit of effort applied elsewhere in the chain prove more useful?

The overall level of analysis applied to a problem will, of course, depend on the amount of resources available for the analysis. In general one would think it reasonable that the overall level of resources committed in the task be related -- i.e., be a small fraction of -- the level of resources at stake in the decision. For example, if the level of benefits or costs expected from a proposed project are in the billions of dollars, it might be reasonable to spend \$1 million -- or even \$2 million -- studying a decision to undertake the project. If only \$1 million is at stake, perhaps \$10,000 to \$20,000 is a more reasonable level of effort.

Once the level of the overall effort is chosen, though, one is faced with the problem of allocating resources within the analysis. This is where the equal marginal improvement concept is useful. What it means in practice is that the amount of effort expended on any aspect of the analysis should be proportional to the sensitivity of the decision to that aspect. Parameters to which the decision is not sensitive (i.e., changing the parameter greatly will not cause a change in the option the analysis recommends) should not be modeled in excruciating detail; similarly, aspects of the analysis to which the decision is in fact sensitive should receive comensurately more attention.

In the end, the analyst should be comfortable that another bit of effort exerted on one aspect of the analysis will produce the same overall improvement in the quality of the analysis as would the same additional effort exerted on any other aspect. (Consider: if this weren't the case, the analyst could have reallocated his effort and improved the quality of the analysis.)

For example, a frequent problem disclosed by our survey of current energy facility analyses is the tendency to expend tremendous effort on the mathematical modeling of such things as air pollution dispersion and oil spill trajectories, while devoting only cursory attention to modeling the events leading up to pollution emission or, equally importantly, modeling, in a way useful to decision-makers, the damage the pollution would do once it reaches land.

This need for a decision-oriented sense of proportion and emphasis extends beyond modeling into the realm of data gathering. Data are useful to decision-makers (as opposed to scientists) only to the extent that the data lend insight to the decision; and such insight depends on the ability of the models to process and structure the data into useful form. The "inventories" that have become a routine feature of environmental impacts statements (EIS) are useless data (from a decision-making point of view) if there is no attempt to relate the inventory in a useful way to the decision at hand. For example, in considering whether to hold lease sale #48, a list of the species resident in the ocean offshore southern California is useless if there is no mechanism to model the likely effects of OCS oil and gas development options on these species and to present the implications of those effects for useful comparison with the other effects of each option.

(An EIS is in many respects a schizophrenic document -- torn between its analytic, decision-oriented role and its well-known strategic role as a vehicle for interest groups (such as local residents and organized environmentalists) to gain veto power over major projects. The next section discusses this issue in more detail.)

Excessive modeling and excessive data collection waste resources. But an error in the other extreme is an equally frequent and a perhaps more serious cause of concern. Insufficient modeling can result in an analysis that is not a useful basis for making decisions. The conclusions of such work are ambiguous or vague, and provide no means explicitly to identify the tradeoffs inherent in the decision.

In many cases, the problem is simply a lack of quantitative approach; the resulting qualitative statements describing a "need for energy" or "potential environmental damage" are worse than useless as aids to decision-makers. In other cases, though, the problem may be more subtle. As noted earlier, many analyses employ sophisticated mathematical models as components; this is certainly no lack of quantitative approach. But what is frequently lacking is a bottom line. Computer-plots of oil spill trajectories and detailed tables of air pollutants in parts-per-million should not be the end-product of an analysis but merely an intermediate step. The ultimate question is, What is the nature of damage expected to occur and how much will this damage likely cost? There is an all-too-frequent tendency to hide behind the results of sophisticated modeling and a general (and perhaps understandable) diffidence about carrying the analysis through to a stage at which the implications are clear. For example, it may be possible to relate oil spills to cleanup costs and air pollution to health effects, thereby providing decision-makers with insights and comprehensible information.

The demonstration analysis in chapter II illustrates that such "modeling through" can indeed be accomplished.

A closely related problem is the failure to deal with incomplete information or to represent uncertainty explicitly. Uncertainty is an unavoidable feature of energy facility siting. How much oil will be discovered in the OCS? What is the probability of an oil spill? What is the likelihood of a tanker collision?

Embodied in many analyses is a misconception about the nature of such uncertainty: that uncertainty is an intrinsic feature of a phenomenon rather than a reflection of one's state of information. This misconception frequently leads analysts to leave out critical parts of the problem when there are "inadequate" hard data. If, however, the analyst takes the latter view -- which is known as the subjective or Bayesian view -- of probability, he will be less diffident about dealing quantitatively with uncertainty and incomplete information.

Once again, the demonstration analysis in chapter II illustrates how this can be done.

C. Analysis in a Strategic Context

An unspoken assumption beneath the arguments of the preceding section is that there is, in some loose sense, a unitary decision-maker who is concerned with making the best decision possible (for him). The central criterion for quality in an analysis, then, is the extent to which the analysis contributes to this decision-maker's ability to choose the option that is best according to his preferences. Toward that end, the decision-maker (and hence the analyst) has no incentive to disguise the real implications of the choices he faces: he wants all the implicit tradeoffs made clear. Furthermore, the decision-maker who stands to gain or lose personally from his decision wants the best possible analysis for his money. He doesn't want resources wasted on unimportant aspects of the analysis, and he doesn't want the work to stop short of the bottom line because of insufficient modeling or failure to deal with uncertainty.

As Volume 3 of this study suggests, energy facility siting decisions are not made by any such single decision-maker. Rather, the siting of a facility involves the interaction of a number of groups, each of which has a different set of things to gain or lose from the siting of the facility. In such a case, the incentives in doing analysis -- particularly public analysis -- may be quite different from those that motivate a unitary decision-maker.

The actors -- the private developer, the federal government, the state and local governments, coalitions of local residents, environmental groups -- are engaged in a game of strategy, each trying to skew the decision in the direction that benefits it the most. Under these circumstances, an analysis -- particularly a visible public analysis like an EIS -- can become a part of the game. The energy facility siting game, as Volume 3 goes on to point out, is really a set of interlocked decisions; and, in this sense, each group is something approaching a unitary decision-maker with respect to its aspect of the game. Each group thus has an incentive to do good analysis on its own and from its own perspective: each wants to know how the facility will affect it, how much it stands to gain or lose from each siting option.

But in the context of the game, no group has any incentive to reveal its thoughts publicly. In fact, it's in the nature of such strategic games that players have an incentive to lie; they have an incentive not only to hide their true preferences but to misrepresent the objective effects as well. In a bargaining process of the type described in Volume 1 -- a process that recognizes and puts to use the strategic-game nature of energy facility siting -- analysis can have a very important role. And, although bargaining can and will proceed even if the parties disagree on the objective effects, the process can be facilitated to the extent that all parties do come to some agreement on the objective effects and limit their haggling to the more subjective business of attaching value to the effects.

From one point of view, of course, it makes little difference in the bargaining if participants misrepresent the objective effects. Since each player has the incentive to do good analysis, each will have a good idea what the effects really are, and the actors will thus quickly detect misrepresentations of fact, interpreting them correctly as strategic moves.

But bargaining of this sort is not carried out under the ideal conditions of theory. The participants are not well-informed individuals each acting for himself alone; rather, the bargainers are representatives of groups. A representative may have personal interests and incentives that are not identical with those of the group as a whole (particularly if the group is as large and diverse as, say, a state government); and the groups may vary greatly in their abilities to analyze the siting decision. More importantly, perhaps, the bargaining takes place in a very public and very political environment. There are frequently groups -- notably organized environmentalists -- who have an interest in the outcome of the siting decision but who have no institutionalized veto power; such groups can and frequently do exert political pressure on the analysis in order to influence the decision.

A frequent point of attack is the environmental impact statement required by the National Environmental Policy Act of 1969 (NEPA) [11] whenever there is a "major federal action significantly affecting the quality of the human environment." Since the inevitable federal permits required to site an energy facility are generally considered to be such major federal actions, an EIS is an important prop in almost all energy facility siting dramas.

A frequent tactic is to claim -- generally in a court of law -- that some aspect of the analysis in the EIS is "inadequate," that some link in the chain of reasoning received insufficient attention [12]. The motivation for such a claim is usually a desire either to attract more attention to that aspect of the siting decision (and thus perhaps to make it weigh more heavily in the decision) or merely to delay or obstruct the decision-making process. (Delay and obstruction are rational strategies for parties who prefer the status quo to all other likely outcomes.) Occasionally, and perhaps frequently, impact statements are indeed inadequate. But, to the extent that an EIS is truly an analysis, truly a decision document, its criterion for selecting the level of detail appropriate to any aspect of the analysis should be the sensitivity of the result to that aspect -- not the sensitivity of analysts to political pressure.

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[11] P.L. 91-190.

[12] This tactic is not exclusive to environmentalists or citizens groups: a large portion of the API v. Knecht suit discussed in volume 1 rests on arguments that OCZM's EIS on the California coastal management program is inadequate.

A good deal of the problem arises from the current tendency to convolve perspectives in the analysis. If an EIS is intended to be a decision document for a federal agency, it should include a clear view from the national or aggregate perspective. From state or local perspectives, the emphases within the analysis would necessarily be different, and those views of the decision should be separated and acknowledged.

One way to improve the analysis in the multiparty context is to institute a system of cooperative analysis as outlined in Volume 1.

Under such a system, all appropriate levels of government would work together on an analysis of the siting decision and would produce, within fixed time limits, a single report or impact statement. This does not mean that they would produce a single analysis. Since each level of government feels the effects of siting differently, each would have different concerns and emphases; more importantly, perhaps, each level of government would have different values to attach to the objective effects. But, even if the resulting document produces three or four side-by-side analyses, it will bring to the fore the underlying distributional problem of energy facility siting, thus providing a common understanding and starting point for bargaining. Furthermore, there would be a tendency for the levels of government to move closer together in their assessments of the objective effects of the siting options -- not only because each would know that any exaggerations or misrepresentations would be countered in the same volume, but because much of the information and data in such a coordinated effort would be garnered from the same sources.

II. DEMONSTRATION ANALYSIS: LEASE SALE #48

A. Summary of Findings

This chapter presents a demonstration analysis of the proposed sale by the federal government of Outer Continental Shelf (OCS) drilling rights off the shore of southern California. The demonstration has two principal objectives.

- To illustrate the analytic techniques and philosophical approach to analysis outlined in chapter I.
- To point out in quantitative terms, the conflicts among interests -- particularly state and national interests -- that frequently underlie large-scale energy development controversies.

The central conclusions of the analysis are:

- Development of the proposed tracts would yield substantial expected net benefits to the nation. And, unless a discount rate of less than six percent is chosen coupled with fairly extreme assumptions about increases in foreign oil prices and the duration of the West Coast oil surplus, there is no reason from an aggregate national perspective, to postpone the lease sale.
- Although expected external costs of the OCS development -- in terms of air pollution and oil spill damage -- are nearly two orders of magnitude less than national economic benefits, those external costs would be borne by the constituents of the state of California and its local governments. These costs may constitute a powerful incentive for state and local opposition to the lease sale.

1. Net Benefits of the Lease Decision

From a national point of view, the important effects of developing the lease sale #48 tracts would be:

- the economic benefits of the oil produced, and
- the external costs of development -- primarily costs of increased air pollution emissions and increased risks of oil spills.

Using an explicitly probabilistic approach, the analysis models these effects and calculates discounted expected-value estimates of the economic benefits and external costs. The results:

- The discounted expected-value market-economic benefits to the nation of developing the lease sale #48 tracts are about $2.3 billion (in 1975 dollars). Of that amount, $630 million would be consumers' surplus benefits, $480 million would go to the federal government in royalty payments, and the remaining $1.2 billion would be split among bonus payments to the federal government, federal and state taxes, and industry profit (above a 10 percent rate of return).
- The discounted expected external costs (oil spill damages and short-term health, material, and vegetation damages due to air pollution) amount to $43 million. The bulk of the cost arises from oil spills ($28 million) while about $15 million of the cost can be traced to air pollution damages.
- Expected direct economic benefits outweigh expected external costs by a factor of more than 50 to 1 from a national perspective, and by more than 10 to 1 from a California perspective.

From an overall national point of view, the federal government should lease the proposed tracts according to schedule and exercise the means at its disposal to redistribute the plentiful benefits such that residents of southern California find offshore oil and gas production in their interest.

Some other conclusions:

- Because the benefits of leasing are so much greater than the estimate of external costs, the use of value judgments different from those used in this analysis would be unlikely, within reasonable bounds, to affect the national decision to lease.
- Benefits from increased local employment and from reduced dependence on imported oil are quite small in comparison with the direct economic benefits of the lease sale.

2. The Distribution of Effects

Despite the large net national benefit from the proposed lease sale, costs and benefits are distributed unequally between the nation as a whole and local and state interests. The external costs of the sale will be borne primarily by the state of California and local areas directly affected. The external cost estimates derive from an analysis performed at a fairly general level, and there may be value to the state in a more detailed look.

Although California would share in the economic benefits of the development - all of the consumers' surplus from gas production along with a 10 percent share of the remainder (in proportion to the state's share of population) would come close to $510 million - the economic benefits and external costs may not balance out for local residents whose property is near the coast or whose businesses are coastal dependent. The problem is compounded since direct economic benefits returned to the state are diffused throughout the entire population, whereas the external impacts are often dramatic and localized. Since the mechanisms do not exist for California to compensate any of the losing localities with the diffused benefits of slightly cheaper oil and slightly lower federal taxes, the state as a whole retains an incentive, in this implicit bargaining situation, to minimize its own gains while stressing its losses. The unequal distribution of effects is both an equity issue and a strategic issue.

The federal government and the lessees -- who stand to gain large benefits from development -- should seek and implement ways to compensate state and local concerns for the expected external costs they will bear. Methods could include lease stipulations, other mitigation measures, or direct (money) compensation.

Public oil-spill contingency funds (such as the one established by the recent amendments to the OCS Lands Act) and private liability already compensate local residents for most of the damages resulting from oil spills. In contrast, air pollution damages, though less than half oil spill damages, are uncompensated and on this basis may prove to be a more severe burden on southern California residents than oil spills.

Stipulations regarding the transportation system used (e.g., pipelines vs. tankers) and other mitigation measures (such as requirements or standards for tanker loading) could eliminate most of the adverse air quality impacts, the largest components of which are due to sulphur dioxide and reactive hydrocarbon emissions. Tradeoffs of the sort proposed for the Sohio terminal and pipeline project might also be considered, upon a demonstration that the cost of clean-up measures is less than the damages caused by increased concentrations.

3. Timing of the Lease Sale

There are two main factors that might influence a decision to postpone lease sale #48:

- The current West Coast "oil glut," or crude oil surplus, and
- Expectations about future increases in the world price of oil.

The "oil glut" is sometimes cited as a reason to delay the lease sale. The demonstration analysis indicates that, while this "glut" does depress the social value of the oil produced from lease sale #48 tracts, it does not change the nation's decision to lease those tracts as planned.

The "glut" has resulted because the output from the trans-Alaskan crude oil pipeline system (TAPS) cannot be handled effectively by West Coast refiners. Partly because of stringent air quality standards, these refiners continue to import lower-sulfur Indonesian and other foreign crudes, leaving the Alaskan oil no West Coast market. Thus, if an additional barrel of high-sulfur oil (such as from the OCS) is produced, an additional barrel of oil must be shipped from the West Coast. This depresses the social value of that additional barrel by the amount of the additional transportation cost.

Depending on the final destination of the oil and the precise route chosen, the value of West Coast crude would be depressed by

- \$.87 to \$1.56 per barrel if the Sohio pipeline route is used;
- \$1.34 to \$1.85 per barrel if the Panama Canal route is used; and
- \$.50 per barrel if the oil is exported to Japan.

Using an average value loss of $1.20 per barrel, the total discounted loss in value would be roughly $18 to $330 million, depending on the duration of the "glut." This leaves unchanged the conclusion that developing the lease sale #48 tracts has large expected net benefits.

Furthermore, postponing the lease sale will not likely offset this loss of value.

In deciding whether to hold the lease sale now (1979) or delay the sale, two economic factors should be considered: the social rate of discount and the rate of escalation of world oil prices.

Assuming a 10 percent discount rate, world oil prices would have to escalate at eight to nine percent per year in real terms before the "delay" alternative is dominant. A nine percent rate of escalation is extremely high. At such a rate, the price of crude in real terms would be $23.47 in 1985, $36.12 in 1990, $57.55 in 1995 and $85.50 in the year 2000. Current estimates of the rate of escalation range from roughly zero to eight percent.

Using published probabilistic estimates of increases in world oil prices, the analysis concludes that despite the "oil glut," net benefits to the nation are greatest if held as proposed in 1979, provided that one assumes a social discount rate of six percent or more.

4. Technical Summary

o Economic benefits

The market-economic (or social surplus) benefits of the lease sale are based on a "social surplus" model, which can be conceptualized simply in the following:

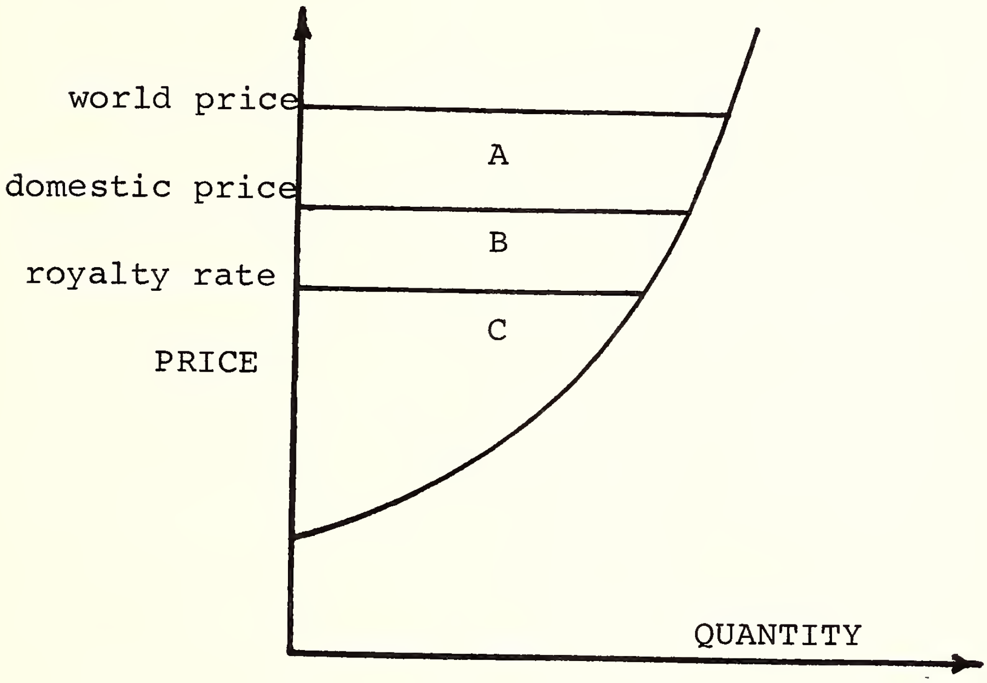

Figure II.A.1
Working Surplus Model.

In this model, area A is the benefit to consumers, B is the expected royalty payment to the federal treasury, and C is divided between the oil industry -- as profits above a normal return to investment -- and the federal government -- as bonus payments, tract rents and taxes. If stipulations and restrictions are put on the development for pollution prevention and abatement, then part of the value of this area could go towards the extra costs of the abatement.

The results of the analysis are given in Table II.A.1. The results on the left are in terms of per barrel average values, in both absolute and present value form. Implicit in the method used to develop costs is the assumption of constant returns to scale in the resource base. Certainly a large field will be cheaper to produce than a small field, and a large resource will have more and larger fields; but what is meant here is a large resource base and a small resource base are expected to have the same proportion of large and small fields *a priori*.

Present value calculations are based on a 10 percent discount rate and a "typical" production scenario.

On the right are presented total present value figures for resource estimates specified as minimum (5 percent chance that resource is less than this), most probable, and maximum (95 percent chance that resource is less).

The production of natural gas is secondary in economic importance to oil, and the value estimates are made according to a simpler model.

- External Costs

The bulk of the analysis on external costs is directed toward examining the health, material, and vegetation costs of air pollution, and serious short-term health effects in particular. Deterministic calculations showed that, from a national perspective, even the worst case would not change the decision to lease according to schedule. However, from a local perspective, more detailed probabilistic calculations are warranted, particularly for use as an aid in redistribution negotiations.

For air pollution costs, first emissions and concentrations increases are calculated. Next, estimates are made of increased cases of premature deaths due to sulphates and carbon monoxide, of aggravations of heart and lung disease

TABLE II.A.1

Net National Direct Economic Benefits (1975 $)

Oil

	Per Barrel		Total Cost and Revenue		
	Total Value ($/bbl)	Present Value ($/bbl)	Min. (47	Prob 715	Max 2333)*
			(Millions of dollars)		
Average cost	$4.90	$1.71	80	1220	3990
Consumer surplus ($14 - $11.50)	$2.50	$ .88	41	630	2040
Royalty (.167 x $11.50)	$1.92	$ .67	32	480	1570
Other (area C) (.833x$11.5 - $4.90)	$4.68	$1.64	77	1170	3820
Total benefits		$3.19	150	2280	7430
Increase from world oil price rise (3.9%/year)		$2.23	105	1590	5200
Loss from West Coast oil glut		- $ .23	11	164	537
Natural Gas					
			(43	860	1968)*
Oil equiv.**	$2.33	$ .82	35	705	1610
Average cost	$ .80	$ .28	12	241	550
Total benefits					

* Minimum, Probable, and Maximum resource estimates for easy reference. Oil is in millions of barrels, gas in millions of Mcf.

** On a thermal basis, 6 Mcf of gas is approximately equivalent to 1 barrel of oil.

due to sulphates and oxidants, and of asthma attacks due to sulphates and oxidants. These cases are valued for the purposes of the demonstration by using National Academy of Sciences estimates of society's willingness to pay to prevent additional cases. Damages to materials and vegetation are estimated via a simple model based on EPA data.

Expected values indicate that health costs will account for 60% of the damages, with damages to materials and residential property accounting for the remainder. (Vegetation damages are negligible.) In terms of pollutants, sulphates will account for 42% of the expected damages, smog/oxidant inducting reactive hydrocarbons - 41%, nitrous oxides - 13%, and suspended particulates - 4%. (Damages due to increased concentrations of carbon monoxide are insignificant).

Oil spill damages are evaluated by comparing them with the costs of the 1969 Santa Barbara Channel blowout. This simple procedure overestimates damages to the extent that the Santa Barbara spill was larger, nearer to shore, and of longer duration than the average expected lease sale #48 spill.

As is often noted, the greatest potential for reducing both air pollution and oil spill costs lies in the construction of pipelines for transporting crude to processing facilities and to refineries (or other trunk pipelines). (Significant reductions in background ambient concentrations would also greatly mitigate lease sale #48 air pollution effects.) If pipelines are not constructed (and they ought not to be if their cost exceeds damage costs resulting from their absence), then it is in the interest of local residents for regulators to issue permits systematically in a manner which minimizes the amount of marine transportation of crude.

Were the lease sale not held, the difference in external costs imposed on southern California residents would approach those figures given above, because the oil produced is not expected to reduce significantly the amount of crude already imported into the region.

- Combined Summary

Net expected benefits and costs are presented in Table II.A.2 on a per unit of production basis. Clearly, direct economic benefits, and their sensitivity to the duration of the West Coast oil glut and increasing world crude prices, by far dominate the costs of local external effects. The present value of the net benefits of each barrel of oil produced amounts to $5.14 and of each thousand cubic feet of gas produced amounts to $0.53.

TABLE II.A.2

Cost-Benefit Summary
(per unit of production - on bbl and Mcf)

Part A: Oil	Absolute	Present Value
Market value of oil	$14.00	
Average production cost	- $ 4.90	
Air quality impacts	- $ 0.04	
Oil spill damages	- $ 0.10	
Net Benefits	$ 8.96	
Present Value (x.35)		$3.14
Present value of incremental benefits from price rise (3.9%/ yr.)		$2.23
Present value of incremental loss from oil glut		- $0.23
Total Net (present value) benefits		$5.14
Part B: Gas		
Oil equiv. value	$ 2.33	
Average production cost	- $ 0.80	
Air quality impacts	- $ 0.02	
Net benefits	$ 1.51	
Present value (x.35)		$0.53

B. Introduction: Problem and Analysis.

Chapter I outlined a concept of "good analysis" and described the important role of such analysis in the siting of energy facilities and other large development projects.

This chapter takes the next step. It presents a demonstration impact analysis with two purposes in mind:

- to illustrate how the approach and the philosophy discussed in Chapter I can be brought to bear on an energy development decision, and
- to analyze an important ongoing coastal energy controversy and thereby to point up the conflict and strategic structure that underlie such controversies.

1. Problem Statement.

The federal government has proposed to offer for lease in 1979 about 1,142,000 acres of Outer Continental Shelf (OCS) lands off the southern California coast for oil and gas development. The designation for this action is OCS lease sale #48. See the map in Figure II.B.1 for a view of the lands currently nominated as well as lands previously leased (most notably in OCS lease sale #35 in 1975).

Control over the OCS was granted to the federal government with the passage of the OCS Lands Act of 1953 [1]; OCS lands are those submerged continental shelf lands which are beyond the jurisdiction of the individual states (3 miles in most cases).

For an in-depth look at the conditions surrounding this lease sale see the case study contained in part 2 of this volume.

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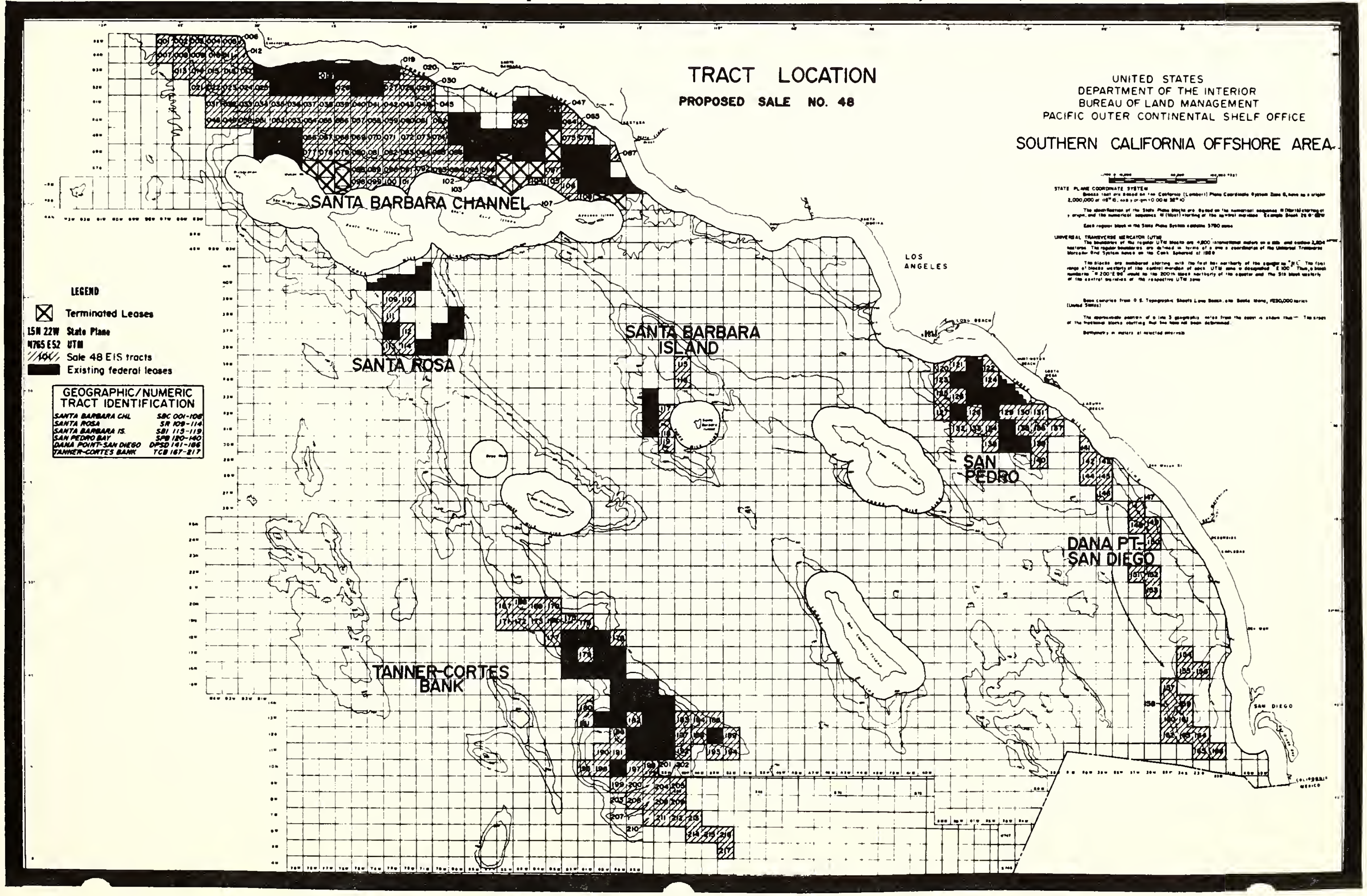
[1] 43 U.S.C. 1331-43.

Figure II.B.1.

PROPOSED LEASE SALE AREA

Proposed Lease Sale 48 includes 217 tracts in the southern California offshore area between Pt. Conception and the U.S.- Mexican border. These proposed tracts comprise approximately 462,080 hectares (1,141,818 acres) located as far as 100 miles from shore in water depths of 23 to 1110 meters (75 to 3,641 feet).


TRACT LOCATION
PROPOSED SALE NO. 48
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
PACIFIC OUTER CONTINENTAL SHELF OFFICE
SOUTHERN CALIFORNIA OFFSHORE AREA
SANTA BARBARA CHANNEL
SANTA ROSA
SANTA BARBARA ISLAND
SAN PEDRO
DANA PT.-SAN DIEGO
TANNER-CORTES BANK
LOS ANGELES
SAN DIEGO
LEGEND
☒ Terminated Leases
15N 22W State Plane
N765 E52 UTM
▨ Sale 48 EIS tracts
■ Existing federal leases
GEOGRAPHIC/NUMERIC TRACT IDENTIFICATION
SANTA BARBARA CHL SBC 001-108
SANTA ROSA SR 109-114
SANTA BARBARA IS. SBI 115-119
SAN PEDRO BAY SPB 120-140
DANA POINT-SAN DIEGO DPSD 141-166
TANNER-CORTES BANK TCB 167-217

Development of lease sale #48 tracts will mean the probable production of about 700 million barrels of oil over a period of more than 20 years. To the nation, this translates into an additional domestic source of oil to help satisfy the economy's demand for energy; revenues for the federal treasury; and profits for industry. To California, on the other hand, it translates mainly into additional air pollution and increased danger from oil spills along the heavily populated and environmentally conscious shores of Los Angeles and Santa Barbara. This divergence of interests is the crux of the problem for lease sale #48 development, and is typical of the type of problem encountered with the siting of coastal energy facilities.

While the leasing of new OCS tracts off southern California will have negligible effects on the energy situation of the country as a whole, its expected value to the nation in the market-place is still in the billions of dollars. It is therefore appropriate that the nation give its development strong consideration as a national objective.

For California, the air quality issue is an important one. Though recent studies have projected that increases in pollution levels from the proposed lease sale will be small, existing ambient levels onshore already exceed federal standards in many areas. California has been charged by the U.S. Environmental Protection Agency (EPA) with developing a plan to ensure that federal standards will be met, as required in the Clean Air Act, by 1981. Thus, increased emissions from OCS lease sale #48, though possibly small in a relative sense, impose a burden on California.

At present, there is some controversy as to whether the Clean Air Act applies to the OCS directly. A recent legal memorandum from the Office of the General Council of the federal EPA dated September 8, 1977, to the EPA Regional Council states that the OCS Lands Act provides the authority for the Clean Air Act to be applied to fixed structures built on the OCS [2]. This memorandum presents the policy of EPA. It has not, however, been tested in court. Even if the policy is found to apply, there remain questions regarding unmitigated sources of emissions, such as those from increased tanker traffic associated with OCS production.

Increased risk from oil spills is of significant concern. The memory of the Santa Barbara spill of 1969 is still very much alive in the minds of state and local citizens and officials.

The final strike against California's interest in further OCS development at this time is the fact that the oil produced will not be of much direct benefit to the state. With the completion of the Alaskan oil pipeline, which is pouring forth 1.2 million barrels of crude daily, the West Coast now finds itself in the midst of an "oil glut" which will probably last through the 1980's. Thus, lease sale #48 is only adding to a situation which will depress the price of oil produced in California and increase national pressure to take on further transshipment projects (such as the Sohio pipeline) and the refining of high sulfur Alaskan and OCS crudes.

In response to this situation, California has demonstrated some opposition to holding another lease sale in the present proposed form and has sought to require a delay in the leasing until certain stipulations on the sale, in the form of mitigation and compensation measures, could be met. The federal response to this conditional opposition has been less than sympathetic.

California would also like to see the passage of the new OCS Lands Act Amendments of 1977 [3] before the lease sale takes place [4].

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[2] AeroenVironment, 1978.

[3] These amendments have just recently been passed by both Houses and await the President's signature. See the Congressional Record (House) August 10,1978 for the text of the legislation.

If agreements are not reached, there are likely to be further delays in future permitting processes and, quite possibly, lengthy legal proceedings. Another possibility is that the current uncertain political situation will make the lease sale unattractive to industry for development at this time. Both of these scenarios would diminish the net benefits (in present value terms) which would otherwise accrue to the nation.

2. Framework for a Decision-oriented Analysis

As was emphasized in the previous chapter, a good analysis must be oriented towards a decision over a well-defined set of alternatives. The alternatives which will provide the focal point for the demonstration to follow are:

- lease as scheduled in 1979,
- do not lease, and
- delay leasing up through 1990.

The decision over these alternatives will be looked at from the viewpoints of both the state of California and the nation.

Selection of this particular framework of alternatives may need some justification, since there are at least two other levels from which the problem has been approached. These could be characterized as lower (or more "micro") level alternatives and higher (or broader, more "macro") level alternatives. Both of these levels have received more attention in California than the approach taken here.

Lower-level alternatives attend decisions which logically come after the main decision to lease:

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[4] California Office of Planning and Research (OPR), OCS Project Task Force, Offshore Oil and Gas Development: Southern California, Oct. 1977, two volumes.

- denomination (removal from the lease sale) of various tracts because they are in more sensitive biological areas, would hinder navigation, or otherwise have deleterious effects;
- stipulations on producers, requiring specific methods and equipment to reduce air and water pollution;
- requirements that the oil and/or gas be brought to shore by pipeline rather than tankers, or that, once ashore, it be shipped for further processing and consumption by pipeline rather than tankers; or
- comprehensive planning of facilities to eliminate redundancy, increase the economic feasibility of pipelines, and mitigate onshore effects.

By looking at the problem at this level, the analysis is in effect conceding the desirability of the lease sale as a whole [5].

The justification for the framework of the present study is that the decision to lease is by far the most important decision to be made and is logically prior to the lower level decisions. In addition, this approach provides a framework and a measure for looking at lower level alternatives through straight-forward extensions of the analysis.

The other, or "higher," level of alternatives is that involving energy policy decisions -- such as alternative energy sources. While these are sometimes cited as alternatives by public officials and the popular press [6], it is in most contexts a source of confusion to consider them as such: they do not in general involve alternative uses of a particular resource (e.g., OCS, geothermal, and solar development) and thus are not mutually exclusive. There is no particular reason that both OCS and the other sources of energy cannot both be developed. Neither is there any particular reason in analyzing them not to consider each project's marginal value separately [7].

---

[5] A report by the California OPR (Ibid) deals with the problem at this level. Stating at one point that "California does not oppose OCS oil and gas development per se," but is concerned for environmental safeguards (p.13, v.1), it avoids analysis of the decision to lease.

Although the general objective is to focus in a quantitative way on the lease sale decision, it is not to say what particular option should be implemented. Rather, it is to clarify explicitly the tradeoffs and value judgments inherent in the decision when viewed from a multi-party perspective and to point out who stands to gain or lose from each alternative. The method is in no way intended to replace the expertise, knowledge, or value judgments of decision-makers, and in fact, is only valid to the extent it incorporates the values of legitimate decision-makers.

---

[6] A recent article in The San Francisco Chronicle ("Brown's Plea to U.S. -- 'Drill Steam, Not Oil,' July 11, 1978) speaks of leasing prime geothermal areas in California as being an alternative to further leasing of California OCS (the reference here is to lease sale #53 off northern California). While this may be a perfectly rational contention from a strategic point of view, it fails by being neither truly global nor marginal in its perspective.

[7] Analyzing the two together would yield extra information only to the extent that there are cross-effects between them that impact on the amount each is valued. Since the value to the nation of developing OCS oil derives mainly from the price of foreign imports, the development of geothermal and solar energy will not affect the decision to develop OCS oil until they cause a significant drop in the world oil price. Unfortunately, they are not expected to do so.

The specific objectives of this analysis are several:

(1) To provide a quantitative framework to assess benefits and costs of the leasing alternatives. (This includes quantifying non-economic effects such as air quality impacts and increased numbers of oil spills.)

(2) To structure and clarify the decision by relating the many complex factors which make up the problem and by identifying those factors that are critical to the decision.

(3) To quantify the uncertainties inherent in these critical factors and to assess the importance of these uncertainties to the decision.

(4) To identify explicitly the distribution of effects among the various parties concerned with the decision. (This is a particularly important aspect of coastal energy facility siting decisions and is a starting point for the multi-party bargaining process discussed in Volume 1 of this report.)

(5) To serve as a framework for further discussion among decision makers (and experts in relevant fields), by pointing out the relative importance of issues of concern.

Ultimately, the decision -- or rather decisions -- to develop or not develop OCS oil and gas resources in a timely fashion will have to be made through the interaction of the various parties and the interests they represent, if not by mutual agreement and bargaining, then via the judicial process.

The analysis is carried out at a fairly general level, reflecting the limited resources which could be allocated to this section of the overall Study. Further analysis at a finer level of detail could be applied to any portion of the demonstration. The questions that must be asked before doing so are:

(1) Would further detail add overall insight into the problem? Would it change the conclusions of the analysis?

(2) Why should the additional resources be devoted to this particular aspect as opposed to another?

3. Overview of the Demonstration Analysis

Important aspects of the lease decision are shown in the conceptualized leasing model of Figure II.B.2. There are four distinct components of the overall framework:

- Oil and gas production model
- Economic impacts model,
- Environmental impacts model, and
- Value model.

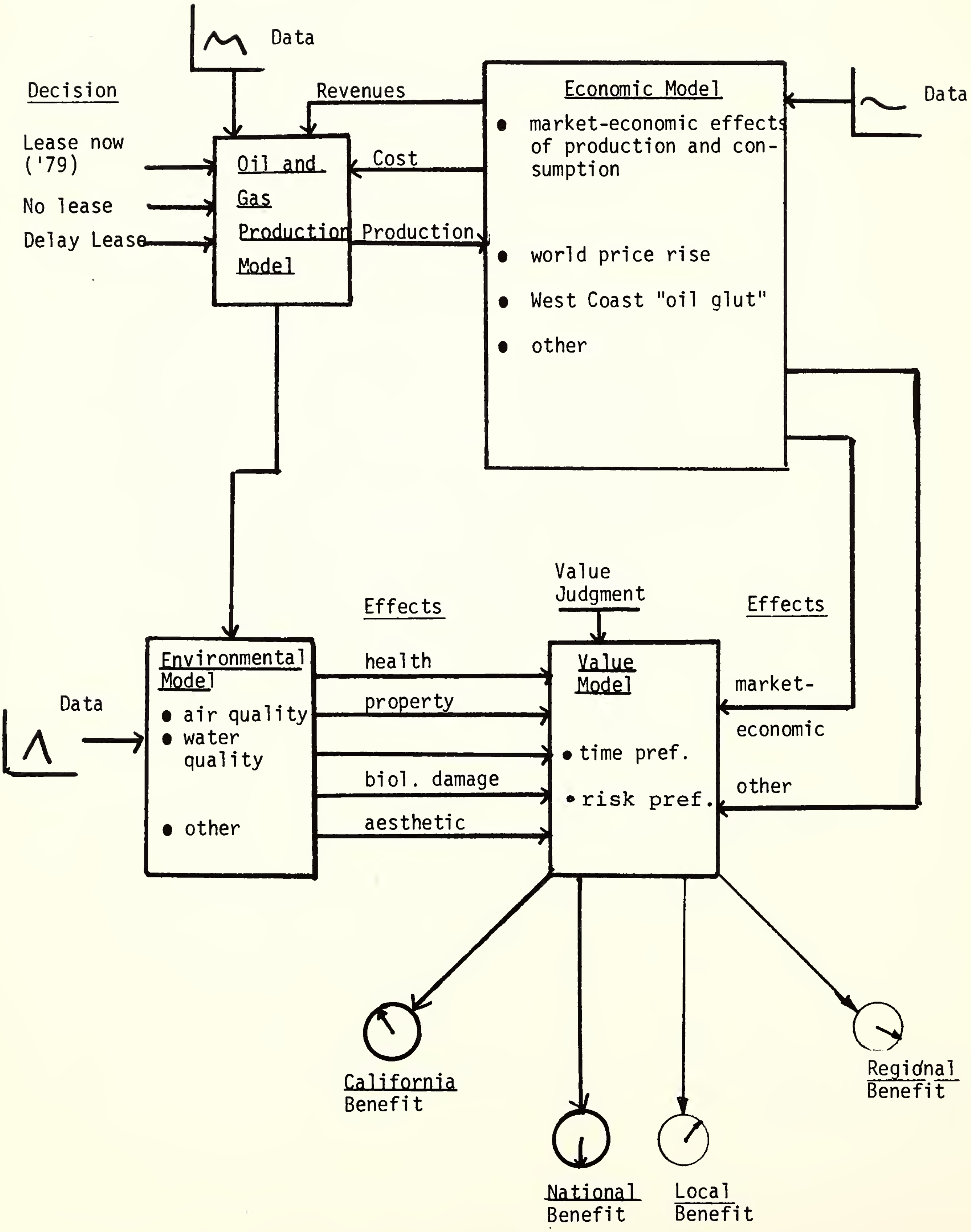
The "economic model" begins with an analysis of the economic costs and benefits of potential increased domestic production from a social surplus or efficiency point of view. In addition, a framework is developed for examining the implications of a delay in leasing given various assumptions regarding rising world oil prices and the West Coast oil surplus.

The environmental model addresses non-economic costs and benefits associated with OCS oil and gas production, such as adverse impacts from air emissions and more frequent oil spills. These "non-economic" impacts are called externalities in the economic literature.

The quantification of the impacts of these externalities requires two types of assessments. The first is a quantitative statement of the damage done; for example, the number of asthma attacks induced by increased air pollution or the number of seabirds killed by a spill. These quantities are generally uncertain, in which case probabilistic estimates are used. The second type of assessment is a value judgment requiring the comparison of economic benefits with external costs. Ultimately, the appropriate values are those of the decision-makers.

Figure II.B.2
Conceptual Model

OCS Lease Sale #48



Since this analysis has not been prepared explicitly for any of the actual lease sale decision-makers, it has not incorporated the critical values. Were a single set of values available (e.g., those of the Secretary of the Interior), then the analysis would end with a recommended option.

The need to quantify explicitly effects and value judgments is emphasized in the analysis and represented in Figure II.B.2 by the value model. The effects, both economic and external, are complex, and will in general occur over a period of time. If not made explicitly beforehand, tradeoffs between external effects and market-valued economic effects will nonetheless be made implicitly in the course of making a decision. Quantifying these judgmental aspects, or at least presenting the framework to do so, provides useful insight.

Finally, the question of distribution of these effects -- is examined and discussed. This distribution analysis suggests a need for establishing or improving institutional mechanisms to facilitate the redistribution of net national benefits to adversely affected regions and localities. When suitable redistributions can be implemented, the resulting action is in the national interest, as defined in Volume 3.

C. Economic Value of Oil and Gas Production from Lease Sale #48

This section begins the demonstration with an analysis of the direct economic effects of lease sale #48 oil and gas production. As can be seen from Figure II.B.2., the economic model comprises simple market-economic effects, the effects of escalating world oil prices, and the West Coast oil surplus or "glut." Section D analyzes effects that are environmental in nature, such as air pollution and oil spills.

1. Summary

The findings of this section include:

- Expected benefits from the development of lease sale #48 tracts given present prices are (in millions of 1975 dollars):

	Total	P.V.*
Consumers' surplus	1,790	630
Royalty payments	1,370	480
Other surplus -- including profits and bonuses	3,350	1170
Total	6,510	2280

- While the present West Coast "oil glut" and rising world oil prices tend to favor delaying the sale, the overall economics favor leasing now (for discount rates above 6 percent).
- The rise in world oil price will increase the value of the oil substantially over those tabulated above. At a 3.9 percent growth rate in world price levels, the most probable net benefit increases from 2.3 billion to 3.8 billion.

The analysis of the present section begins with the development of the market-economic effects of the oil produced, based on a fairly simple and straight-forward model of these effects. Once the analysis has been developed for simple assumptions (constant oil prices over time and a 10 percent per annum discount rate), it is then possible to expand the analysis to consider the effect of rising world oil prices and the West Coast "oil glut."

---

* Present value in 1979, using a discount rate of 10 percent, and a present value factor of .35 (see below).

2. Social Surplus and Offshore Oil Development

The most direct benefits from the lease sale arise from the oil and gas which will be produced; the most direct costs are those borne by the oil industry in exploration and production. These direct benefits and costs are often taken for granted and ignored in analysis; in place of any measures of such benefits, people often speak carelessly of the "need" for the oil, or the national interest in the development of OCS. In some cases, the net benefits are so great that, from a decision-oriented viewpoint, there is no reason to measure the benefits further: the decision is obvious. But in many cases the outcome is less obvious, and the idea of "need" leaves no way to make comparisons with other costs of the development, such as air pollution. Furthermore, reliance on intuitive judgments that the development is or is not nationally significant in filling a need tends to degenerate into looking at the size of the project. A large development will appear nationally valuable even if it is expensive and environmentally dirty, whereas smaller developments will not be nationally significant, and therefore not considered, even if they are cheaper and cleaner.

Valuing market-economic effects by means of consumers' and producers' surplus has already been discussed [1]. This section will build on that discussion and show how to apply those concepts to offshore oil development.

---

[1] See Section I.A.1.

The model presented in Chapter I to describe market-economic benefits needs some refinement for the particular context of OCS oil.

Oil is bought and sold in a world market, with the U.S. participating very heavily in that market. As a result:

(1) Lease sale #48 will provide only a very small fraction of the total market (approximately .3 percent at peak production) [2]. This gives rise to the model in Figure II.C.1, with S the supply from lease sale #48 at various costs [3] and a horizontal demand curve, D.

(2) The value of the oil is approximately the price of oil on the world market (p in Figure II.C.1) when delivered to the U.S. The federal government currently controls the price of oil in the U.S. through the entitlements program, but the marginal cost of any barrel of oil used is nevertheless the world price. This will be discussed further in the section below on pricing.

To see the relationship between Figure II.C.1 and Figure I.A.3 of the previous chapter, consider Figure II.C.2., which is a blown-up version of Figure I.A.3. The demand curve is relatively flat because the horizontal axis has been expanded many more times than the vertical axis. Figure II.C.1. can be derived from Figure II.C.2. by subtracting (horizontally) S from S' (which will leave area D unchanged) and by ignoring areas B, and C, which from [2] above should be small. That is, anticipated production from lease sale #48 will not significantly depress world oil prices, and consequently areas A, B and C are assumed to equal zero. Another lesser reason for ignoring areas A, B, and C is that the surplus generated and transferred would accrue to the world as a whole, and thus is less significant from a national perspective.

---

[2] U.S. Dept. of the Interior expectations for peak production are 220,000 bbls/day in 1986, while recent studies indicate a non-communist world production of 60-70 million bbls/day in 1985. (See Robert Mabro, "Energy Crisis in 1985?, Supplement to Middle East Economic Survey, vol. XXI, no.25 10 April, 1978).

[3] Many of the variables defining this curve are uncertain, so that S should really be defined as the supply (or cost) curve given a particular estimate of the resource base, size and location of fields, and other technical variables.

a. U.S. Oil Pricing

The price of domestically produced crude oil in the U.S. is currently controlled by the Federal Energy Regulatory Commission. [4]. Oil from "old" wells is assigned the lower-tier price (about $5.25/bbl in 1977), while oil from "new" wells may be sold at the higher, upper-tier price (about $11.50/bbl in 1977). Both price levels are below the world price (about $14.00 bbl in 1977). [5]. Since lease sale #48 would lead to new development, the oil produced would be allowed the upper-tier price. (There are exemptions to the simple "new-old" classification scheme for wells that are so depleted that they are no longer profitable under the controlled prices. Oil from these marginal or stripper wells is sold at approximately the world price.)

With the sudden rise in world prices in 1973, those oil companies which produced their own relatively cheap domestic crude -- primarily large vertically integrated oil companies -- suddenly had a large competitive advantage over those refiners who relied on foreign oil -- primarily smaller independent firms.

---

[4] The pricing mechanisms described here were created by the Emergency Petroleum Allocation Act of 1973 and later modified by the Energy Policy and Conservation Act of 1975 (PL 94-163).

[5] U.S. Department of Energy, Monthly Energy Report, March 1978, pp. 73,76.

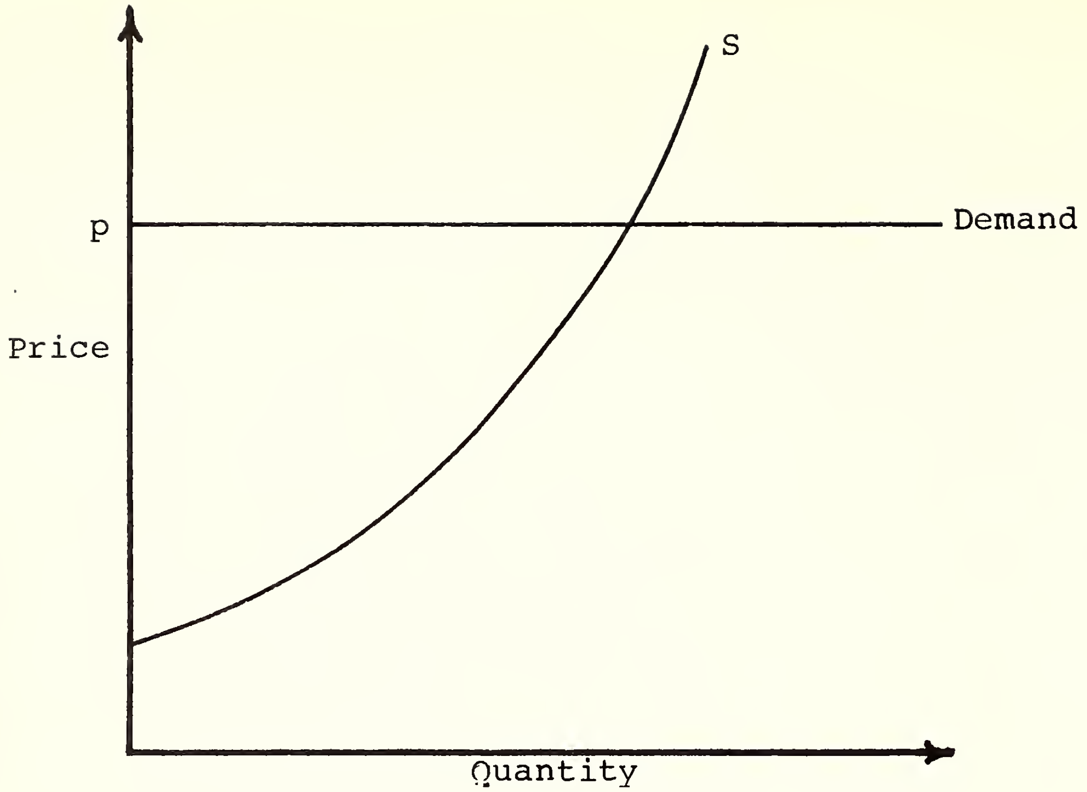


Figure II.C.1.

Horizontal Demand Curve

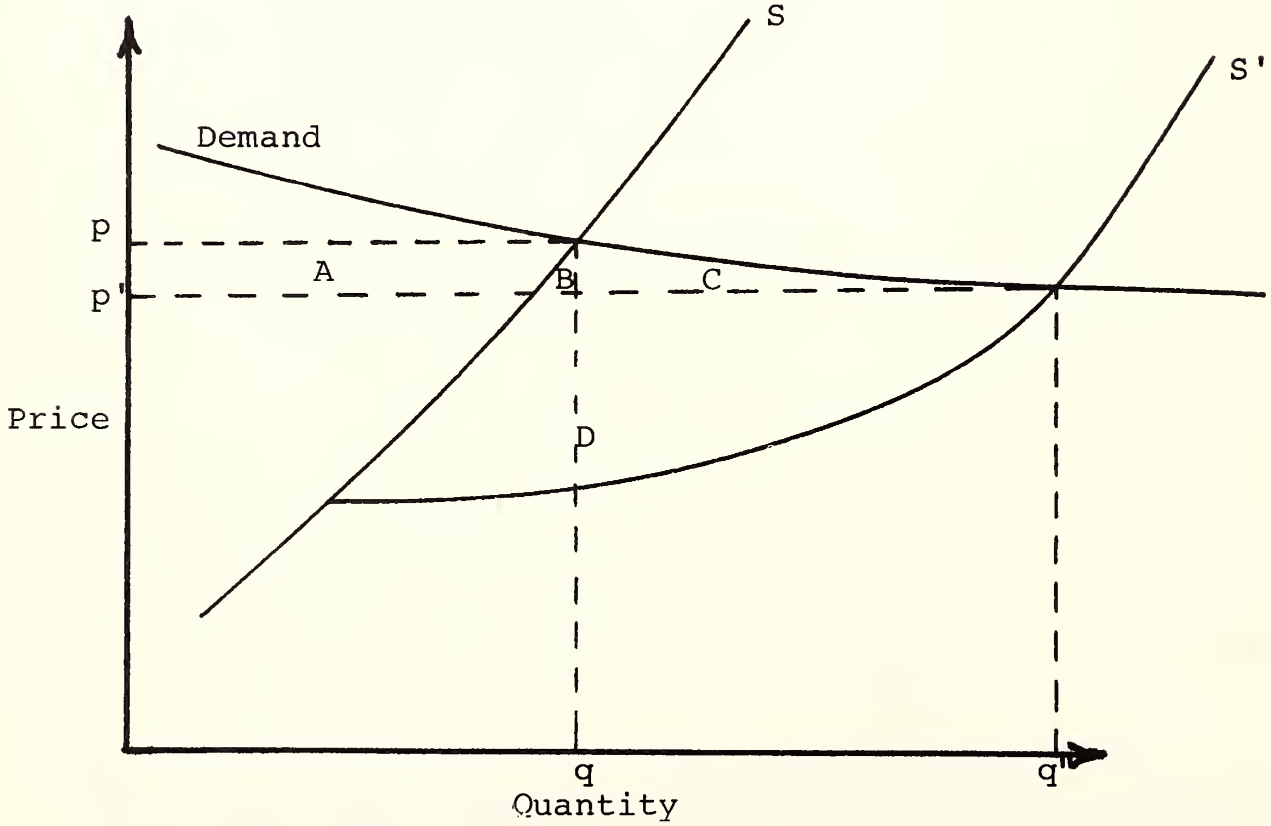


Figure II.C.2.

Magnified Social Surplus Diagram

Both to forestall the "windfall" profits which would have accrued to the large vertically integrated companies, and to blunt the effect on competition of putting the smaller independent firms at such a disadvantage, price controls were placed on domestically produced crude. However, price controls alone would be ineffective in achieving these two objectives. This is because a large fraction of the crude processed by the vertically integrated companies is already owned by these companies. Since price controls cannot be effectively administered over internal transfers, they would apply only to a small fraction of the nation's crude conversion.

To make price controls effective against vertically integrated companies a system of entitlements was established. Under this program, the Department of Energy (DOE) determines the "National Domestic Crude Oil Supply Ratio," which reflects the nationwide ratio of lower-priced domestic crude to higher priced crude. Refiners who process a fraction of low-cost oil less than this ratio are issued entitlements by DOE; refiners who process a higher fraction of low-cost oil must purchase the entitlements at a price specified by DOE -- one entitlement for each barrel of low-cost oil in excess of the national percentage.

The effect of the entitlements program is to equalize the cost to refiners of crude oil. Curiously, the entitlements program creates inefficiencies which decrease the value of oil from the OCS [6]. The view taken in this chapter is that since the nation is a net importer of oil , the world oil price is the correct value for domestically produced oil since an additional barrel can be obtained at that price and not the average price generated by the regulatory scheme. While some of the inherent value of the additional barrel is lost artificially via the entitlements program, this loss should be part of an analysis of whether or not to have an entitlements program, not of whether or not to proceed with domestic oil development.

---

[6] The entitlements program causes the consumer of oil to see a marginal price that is a weighted average of the domestic and world price, which is lower than the true marginal cost - the world price. This creates a "consumers' deficit" because consumers as a whole pay more for some of the oil than they would be willing to pay. The result is that too much oil is consumed, and especially too much foreign oil.

b. Leasing and the Distribution of Surpluses

A closer look at the surpluses, or economic rents, which are measured by the present model will clarify both the OCS leasing process and the interpretation of surplus measures as the relevant values.

A natural way to measure economic benefits is to ask: How much are the consumers of this energy willing to pay for each additional quantity? The difference between what a consumer would be willing to pay and what he actually does pay is called his consumer's surplus. Similarly, the difference between the minimum price that a producer can produce at (i.e., cost, including a "normal" return to investment) and the amount he actually received is called producer's surplus. These measures are the area below the demand curve (which describes the "willingness to pay" at a given price) and above the supply curve (which describes the "willingness to produce") respectively.

The areas specified in the following are shown in Figure II.C.3.

Area A: Consumers' surplus. Since the demand curve seen by producers of crude from lease sale #48 is flat, there is no consumers' surplus like that discussed in chapter I, section A.1 above. By controlling the domestic price of oil, the wealth that would have been producers' surplus in

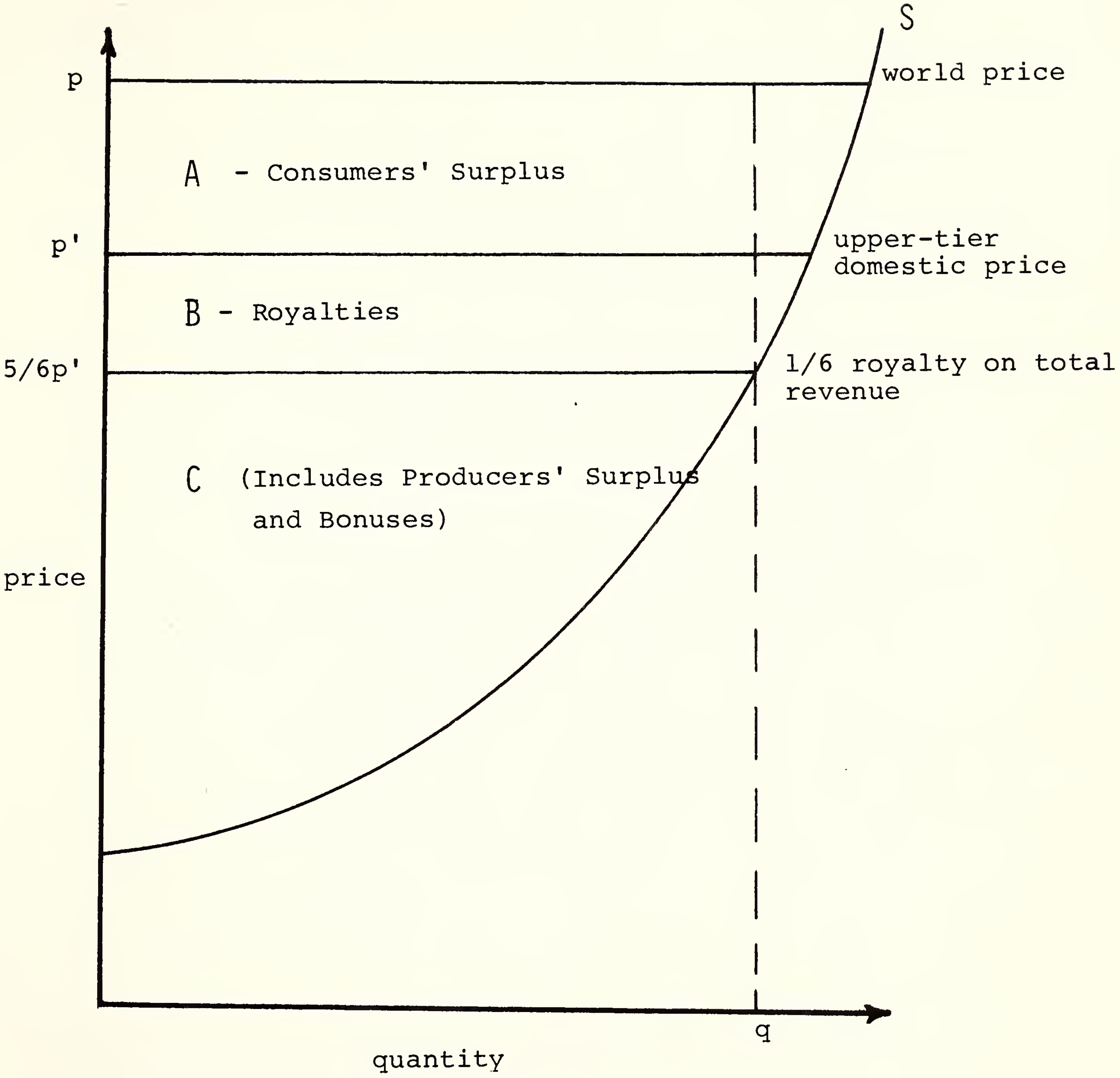

S
p
world price
A - Consumers' Surplus
p'
upper-tier domestic price
B - Royalties
5/6p'
1/6 royalty on total revenue
C (Includes Producers' Surplus and Bonuses)
price
q
quantity

Figure II.C.3.

Working Surplus Model.

area A is transferred to consumers. Instead of paying pq for q barrels of oil they pay p'q -- the difference is area A and corresponds directly to A dollars being retained by consumers [7].

Area B: Royalty payments. One-sixth of net revenues earned by the oil companies is collected by the federal government as royalty. Area B thus is translated directly into revenue for the federal treasury.

Area C: Bonus payments or industry profits. OCS leases are assigned primarily via a bonus bid system. That is, when the tracts are put up for lease, as they are currently scheduled to be for lease sale #48 in early 1979, the right to explore further and develop each tract is bid for by any interested American oil company on a competitive basis. When payment of the amount bid is made in full at the time of the lease sale, this is known as a bonus bid. (Bidding is occasionally done on royalty payments made at the time of production.) Under ideal market conditions of similar information, expectations, techniques, and costs among companies, and with no collusive agreements among companies, all of area C would be bid away as bonuses to the federal government. To see this, consider a company bidding less than C, where the diagram in Figure II.C.3. is now to be interpreted as describing the expected production from a single lease tract. Another company could then make positive profits by bidding just slightly more than the first company -- and, under ideal conditions, this process will continue until there are no profits left.

It is important to know in this connection that the supply curve of Figure II.C.3 includes normal returns to investment, or the opportunity cost of capital. (The opportunity cost of capital equals the maximum return foregone by not investing in other alternatives.) The actual value of a "normal return" will depend on the structure and capital situation of the industry and the economy as a whole, and the risk of the development. It may be very high (25 percent or more). The present analysis will generally assume (somewhat arbitrarily) a discount rate of 10 percent.

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[7] Some of this surplus is lost, though, because of the market distortions cited above (Ibid.).

Of course, under less than "ideal" conditions, some of the surplus in C may end up as profits in excess of the normal returns suggested by the competitive paradigm. Any company that makes a chance discovery of an oil field before the bidding, makes a technical breakthrough in extraction methods, or for any reason has a competitive advantage over its fellows, can capture part of C as profit. Oil companies could also capture C as a group if they can collude to hold down bidding, or if the structure of the industry is such that competition is not effective.

The analysis to follow is content (perforce) not to consider such questions -- though they may be of interest -- but simply finds the area C. While the imperfections do have efficiency ramifications, their principal effect is that of changing the distribution of the "pie" among producers, consumers, and the government.

In addition to bonuses and profits, some of the surplus in area C will become rent payments on tracts leased ($3.00 per acre for unproven areas and $10.00 per acre for proven areas) and to various taxes (including the corporate income tax).

Finally, note that area C represents an expected surplus at the time of leasing. If, say, prices should rise more than expected by the market during the life of the development of an area, then "windfall" increases of all three areas, A, B and C, could occur, with all of the increase in C going to the industry. Similarly, if the quantity of oil discovered is more than expected (corresponding to moving S in Figure II.C.3. to the right), the industry will again receive extra profits from the increase in C. This possibility is balanced by the losses they will incur if less oil is discovered.

To anyone familiar with cost-benefit analysis in general, there would seem to be nothing very innovative about this approach to measuring benefits. However, in the past it has not been a part of most such analysis [8], nor is it used for making tradeoffs between production and external (e.g., environmental) costs. One of the reasons for this seems to be that government estimates of expected bonus bids (which are basically computations of producers' surplus) are considered proprietary. As such, they often are not even computed (by Interior's Bureau of Land Management and Geological Survey) until shortly before the lease in order to decrease the probability of unauthorized disclosure. A second reason for the absence of surplus calculations seems to be that other groups outside of the federal government and industry, concerned mostly for the environment or other non-market effects, have little incentive to compute expected surplus, since these computations often favor the argument for production. Despite these factors, the analysis here begins with a surplus calculation because (1) the best way to get insights into making tradeoffs among conflicting objectives is to look at all of the outcomes together and devise some means of comparing them, and (2) the fact that the best information is proprietary is no reason not to use whatever information _is_ available. The only alternative to (2) is to make the decision based on no information or on unstated assumptions -- which, because they are unstated, cannot be challenged or analyzed.

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[8] e.g., The Draft Environmental Impact Statement (DIES) on Lease Sale #48, or the study by OPR (_op. cit._).

In a bargaining situation, it could be to the state's benefit to compute such surplus measures -- either to show that net national economic benefits are smaller than the state's losses from adverse externalities, or that there are plenty of benefits with which the nation could compensate the state and locality for bearing the increased risk of adverse external effects.

3. Cost and Benefit Calculations for the Base Case.

Up to this point, the discussion has centered on general issues associated with valuing the production from lease sale #48. The purpose of this is to perform the calculations necessary to obtain estimates of the areas and values of Figure II.C.3. above.

To simplify the development, this section assumes a constant value of oil over the life of the project. Modification of this base case to allow for changes in value over time (from both probable increases in the world oil price and the West Coast "oil glut") are developed in subsection 4. below. These value changes are especially relevant to the question of whether to delay the lease sale.

The analysis to follow is based on publicly available resource, production, field size, and cost information.

a. The Oil Resource Base

Resource estimates are often a source of controversy. One reason for this is that much of the relevant data resides in private hands or, if the information is turned over to the federal government, it is still regarded as proprietary and not disseminated further. To the extent that both costs and benefits are proportional to the size of the resource base, the existence of positive net benefits is not affected by the size of the resource.

The U.S. Geological Survey resource estimates for the tracts of lease sale #48, in terms of low (95 percent probability that actual resource is larger), high (5 percent probability of actual resources being larger) and most probable amounts (50 percent probability of actual resources being larger or smaller) are given in Table II.C.1. below.

Table II.C.1

Total Recoverable Reserves
Lease Sale #48

	Oil (million bbls)	Gas (million Mcf)
Minimum	47	43
Most Probable	715	860
Maximum	2333	1968

Source: U.S. Geological Survey

Estimates of production over time are based on historical production profiles from typical fields. The particular production profile shown in Figure II.C.4 and Table II.C.2 is derived from U.S. Department of the Interior (BLM) estimates. While the shape of this production curve over time will have an effect on the present value of the benefits, the effect is small in comparison to the effect of uncertainties over the extent of the resource base and the date production begins. That is, moving the curve in Figure II.C.4 up or down (uncertainty in resource) or to the right (uncertainty in delay of initial production) are much bigger sources of change in the present value of the outcome than are minor variations in the shape of the curve which leave the underlying area constant. (The curve is said to be normalized because the area beneath it, i.e. its integral, equals one).

Table II.C.2

Probable Yearly Oil and Gas Production

Lease Sale #48

Year	Annual Production		Daily Production	
	Oil (Mbbls)	Gas (MMcf)	Oil (bbls)	Gas (Mcf)
1979	0	0	0	0
1980	0	0	0	0
1981	0	0	0	0
1982	5,000	6,000	13,700	16,400
1983	21,100	25,000	57,700	69,600
1984	43,400	52,200	118,900	143,000
1985	68,500	82,400	187,700	225,800
1986	80,200	96,500	219,700	264,400
1987	78,800	94,800	216,000	259,700
1988	67,500	81,200	185,000	222,500
1989	53,700	64,600	147,000	177,000
1990	42,100	50,600	115,400	138,600
1991	33,700	40,500	92,400	111,000
1992	28,300	34,000	77,600	93,200
1993	24,700	29,700	67,800	81,400
1994	22,000	26,500	60,300	72,600
1995	19,800	23,800	54,300	65,200
1996	18,100	21,800	49,500	59,700
1997	16,600	20,000	45,500	54,800
1998	15,300	18,400	42,000	50,400
1999	14,300	17,200	39,300	47,100
2000	13,300	16,000	36,500	43,800
TOTAL*	666,400	801,600		
RES.**	715,000	860,000		

* This cumulative total is for 18 years of production only; production may continue at a declining rate.

** Total resource (most probable estimate from Table II.C.1).

Source: USDI, 1977.

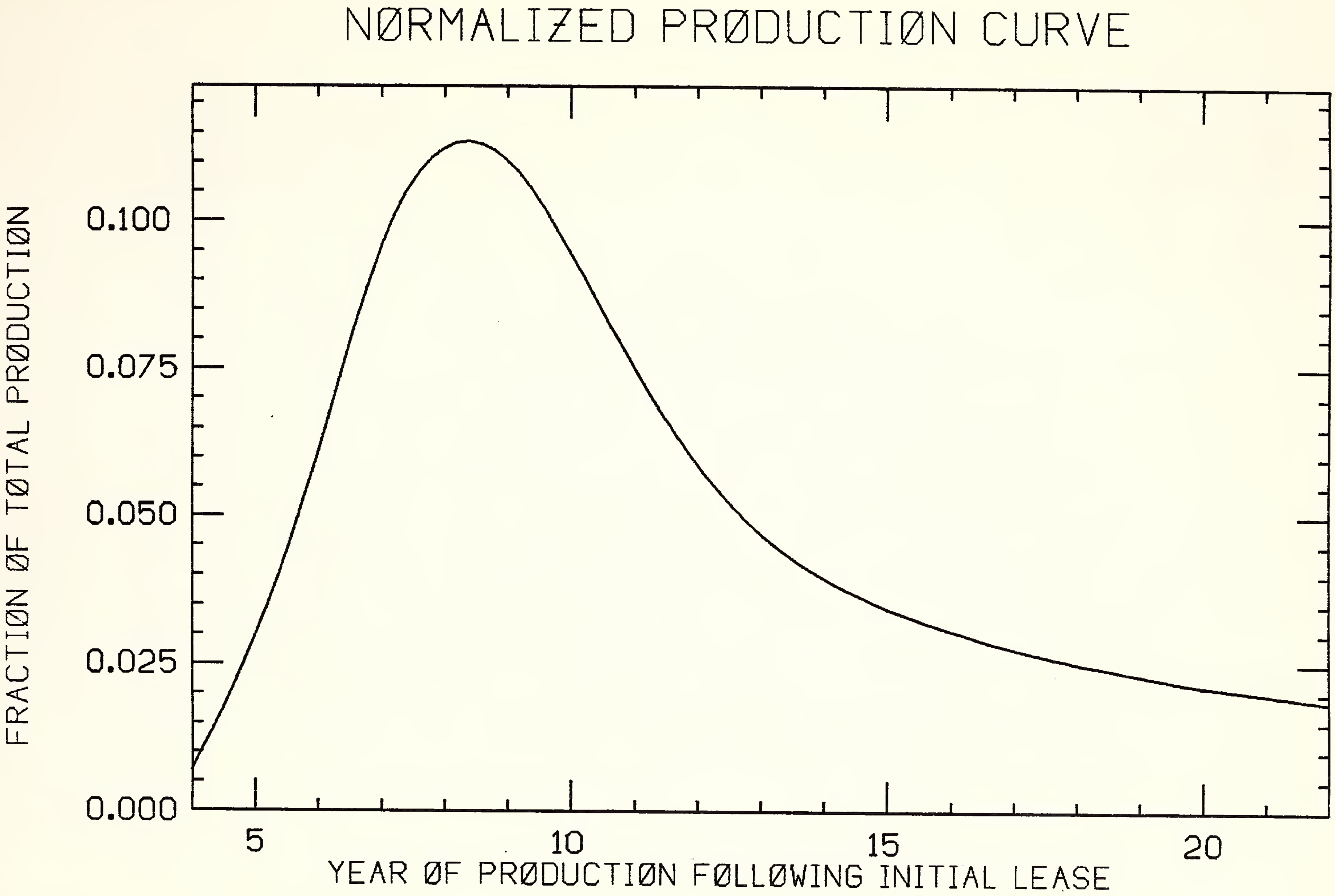
NORMALIZED PRODUCTION CURVE
FRACTION OF TOTAL PRODUCTION
0.100
0.075
0.050
0.025
0.000
5
10
15
20
YEAR OF PRODUCTION FOLLOWING INITIAL LEASE

Figure II.C.4

b. The Cost of Oil Production

The initial estimates developed here for the cost of oil produced from lease sale #48 are based largely on cost estimates for Outer Continental Shelf oil and gas developed for BLM by Arthur D. Little, Inc. (ADL) [9]. Primary cost data and more detailed knowledge of the profitability of a particular tract are not generally available, because such information is either non-existent or proprietary. In any event, a more detailed analysis would not be justified until it can be shown that the decision is sensitive to uncertainty in the initial cost estimates.

The ADL study conveniently presents costs in the form of a Minimum Required Price (MRP) for production of various sized fields. MRP is defined as "that constant price over the life of the field at which field production will pay for the development and operating costs of the field with an allowance for royalty and tax payments and for the company's capital costs" [10]. Thus, the MRP is roughly the cost of production on a per barrel basis at the time of production, assuming a given interest rate. The bonus (which is a payment based on competitive bidding for the right to develop a tract) is not included in the MRP because, when the expected price is the minimum required price, the expected bonus bid is zero. There are no profits above a normal return to investment to bid away as bonuses. In Figure II.C.5, MRP curves as a function of field size are given for offshore California for three different interest rates (10 percent, 15 percent, and 25 percent). The parameters given in the Figure II.C.5. are roughly average values for lease sale #48 [11].

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[9] Arthur D. Little, Inc., Outer Continental Shelf Oil and Gas Cost and Production Volume: Their Impact on the Nation's Energy Balance to 1990, report to the U.S. Bureau of Land Management, USDI, Contract No. 08550-CTS-48, July 1976

[10] Ibid, p. II-18.

The desired form of the cost relationship for purposes of measuring producers' surplus is cost (or MRP) as a function of quantity produced. Costs are quite sensitive to the sizes of individual fields because of economies of scale -- the larger the fields, the fewer platforms, wells, and pipelines needed to produce a given amount of oil. The lower-cost oil from larger fields will be produced "first," i.e., at lower prices (not necessarily first in time).

Transforming the MRP curves of Figure II.C.5. into cost curves as a function of quantity produced requires taking proper account of the two random variables: field size (s) and total resource (q). Field sizes are thought to be distributed log-normally for the United States as a whole [12]. The exact form of the equation is given by ADL as:

$$f(s) = \frac{1}{\sigma s \sqrt{2\Pi}} \exp \left[\frac{-[\ln s - \mu]^2}{2\,\sigma^2} \right]$$

where $\sigma = 2.37$, σ^2 denoting the variance of a normal distribution, and

$\mu = 6.064$, μ denoting the mean of a normal distribution.

The expected value of s is:

$$\bar{s} = \exp\,[\sigma^2/2] + \mu = 7130 \text{ Mbbls}$$

---

[11] There are some caveats which must attend the present assumption of parameter values, however. The most disturbing assumption is that average water depth is 600 feet. In fact, some wells are generally expected to be drilled in over 1200 feet of water. If this happens, costs as presented here will be low. Higher production costs would reduce somewhat the expected economic benefits of OCS production.

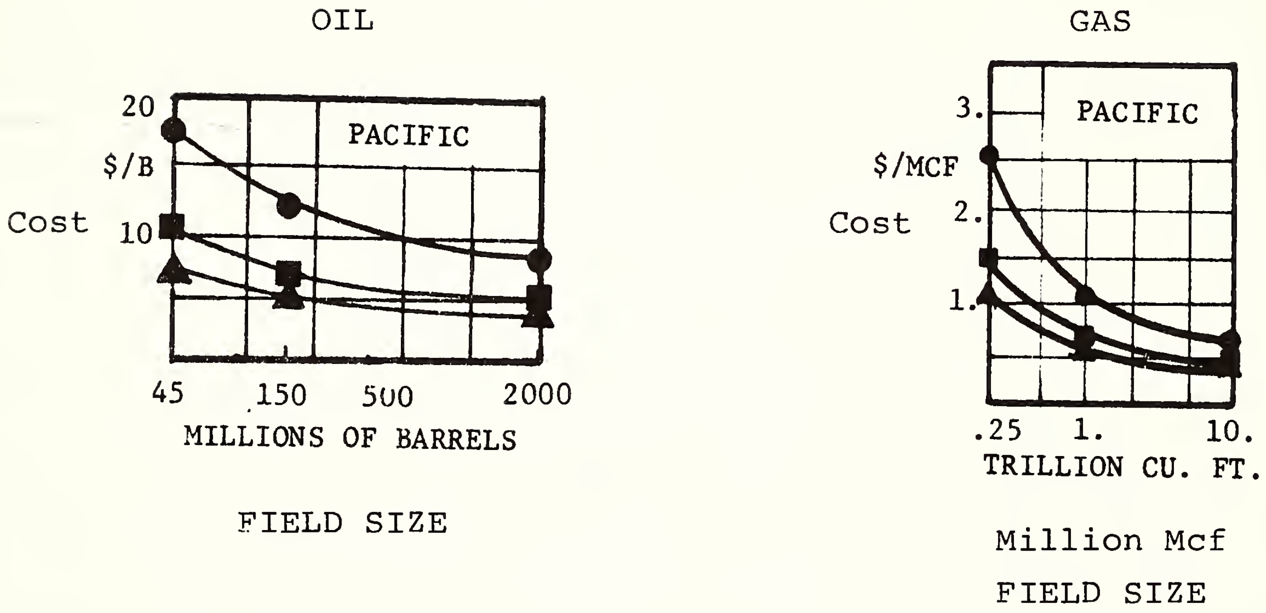
[12] ADL, *op. cit.*, p. III-5

Figure II.C.5

COST DATA

Minimum Required Price

for Production



MRP for oil and gas based on an average water depth of 600 feet, an average distance to shore of 15 miles, an average well productivity of 500 bbls/day, and four years to first production. Values are given as a function of field size for various interest rates.

- ▲ - 10 per cent discount rate
- ■ - 15 per cent discount rate
- ● - 25 per cent discount rate

Source: Arthur D. Little, Inc. op.cit.

Since at present there is no reason to believe that the size of California OCS fields will be distributed any differently (at least the authors have no reason for any such belief), the above probability density function will be used as the appropriate subjective probability function for the size of a field.

One more relationship is needed, the transformation from expected field size to q:

$$q = n\,\bar{s}$$

where n is the random variable denoting number of fields.

Thus $\bar{n} = \frac{\bar{q}}{\bar{s}}$, [13]

and

$$\left[\begin{array}{l}\text{Expected quantity of oil}\\ \text{from fields above size}\\ \text{s, given resource size}\\ \qquad\qquad q\end{array}\right] = \bar{n}\int_s^{\infty} f(t)\,t\,dt, \qquad (2)$$

where t is a dummy variable for s in the integration.

Of these 118 fields, only 9 percent, or 10.6, are expected larger than 10 million bbls ($f(s \geq 10) = .09$). Only 6 percent, or 7 fields, are expected larger than 20 million bbls, and only 1 percent, or about 1 field, is expected larger than 100 million bbls. These figures are based on the log-normal distribution of equation (1).

---

[13] Actually, since q is economically feasible resource and since [ADL] gives a figure of 18 million bbls as a minimally feasible field size at 10% interest, an arbitrary value of 10 million bbls is assumed to be the minimal economic field size. This is used to compute $\bar{n}$ as

$$\bar{n} = \frac{\bar{q}}{\int_{10}^{\infty} f(s)\,s\,ds} = \frac{715 \text{ MM bbls}}{6.07 \text{ MM bbls/}_{\text{field}}} = 118 \text{ fields}$$

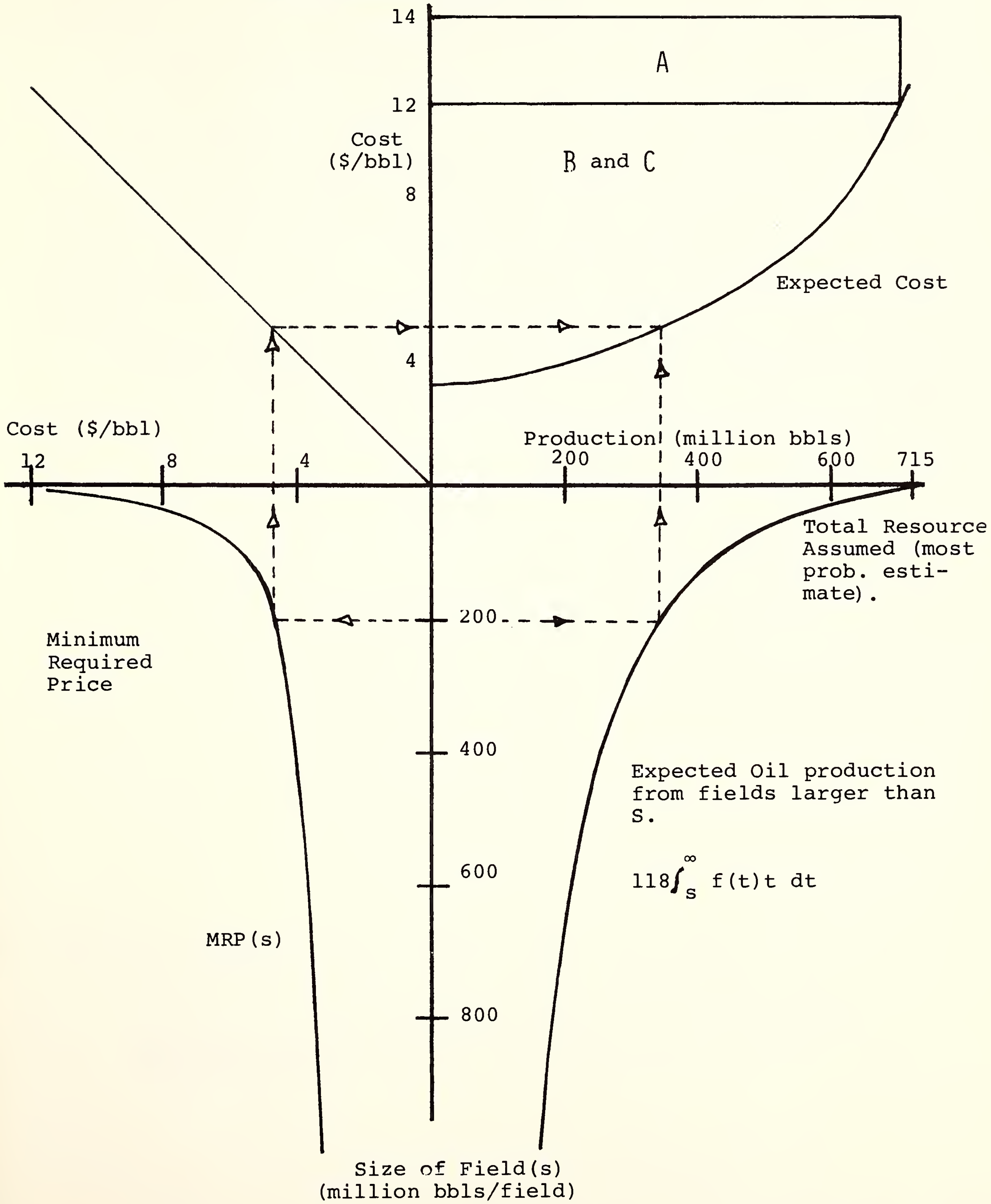
All that remains to be done is to combine these (i.e., equation (2) and MRP as a function of field size, MRP(s), in Figure II.C.5.) into a single cost curve. A graphical representation of this procedure is given in Figure II.C.6. To find a point on the cost curve, take any s from the lower vertical axis, say two hundred million bbls/field. Then find the corresponding value on equation (2)'s graph, which is about 3.5 hundred million barrels produced, and on MRP(s), which is about 4.70 $/bbl. Together, these give a point on the cost curve, which is plotted by the intersection of vertical line from equation (2) and a horizontal line reflected through a 45 degree line from the point on MRP(s).

This is an expected value cost curve given expected values of the resource base, a field size distribution, various descriptive parameters such as water depth, and a derivation of MRP(s) by ADL. The curve itself is unattainable in the sense that large fields can only occur in integer numbers (just as no real family can have the "typical" 4.2 members), while the expected value incorporates smaller and smaller fractions of larger fields. The actual encountered costs will either fall below, if one or two fairly large fields above 200 million barrels are discovered, or above if there are no large fields.

Figure II.C.6

DERIVATION OF COST CURVES

(all costs are 1975 $)


14
A
12
Cost
($/bbl)
B and C
8
Expected Cost
4
Cost ($/bbl)
12
8
4
Production (million bbls)
200
400
600
715
Total Resource Assumed (most prob. estimate).
200
Minimum Required Price
400
Expected Oil production from fields larger than S.
600
$118\int_{s}^{\infty} f(t)t\,dt$
MRP(s)
800
Size of Field(s)
(million bbls/field)

c. Present Value Calculations

As given up to this point, the expected cost curve is the cost over the life of the project. Some account still needs to be taken of the shape of the cost stream over time. One way to do this is to compute the present value, based on the assumption that for all field sizes the expected shape of the production stream (and therefore of net revenue streams) is that of Figure II.C.4. This assumption seems reasonable as a first approximation, given the relative insensitivity to minor deviation in payment streams and the expected value nature of the argument. If for Figure II.C.4. Prod is total production and Prod(i) is production in year i (where year 1 is 1979), then a present value factor, PV(r), can be computed for a normalized payment stream with the shape of Figure II.C.4. and with interest rate r.

$$PV(r) = \sum_{i=1}^{n} \frac{Prod(i)}{Prod} \frac{1}{(1+r)^{i}}$$

For an interest rate of 10 percent, this factor is .35 (PV(.10)=.35).

d. Direct Economic Benefits of Oil Production.

Measuring the appropriate area in Figure II.C.6 gives the absolute net benefits for the most probable resource estimates as tabulated in Table II.C.4 [14].

Implicit in the method used to develop costs is the assumption of constant returns to scale in the resource base over the range of probable values of the resource. Certainly a large field will be cheaper to produce than a small field, and a large resource will have more and larger fields; but a large resource base and a small resource base are expected to have the same proportion of large and small fields *a priori*.

Because of this linearity, the cost results can be proportioned to the size of the resource base. This allows the computation of the minimum values also contained in the table.

---

[14] Before measuring these areas, one more calculation has to be performed: the cost curve is adjusted for the fact that it includes royalty payments. But the royalty payments it includes are one-sixth of the *minimum required price*, whereas the royalty payments for the actual price are contained in area B.

Table II.C.3

OCS Lease Sale #48 National Economic Benefits from Oil Production

(Millions of 1975$)

TOTAL REVENUES

	Min (5%)	Most Prob	Max (95%)
Resource base (million bbls):	47	715	2333
Area A: Consumers' surplus	118	1790	5830
Area B: Royalty payments	90	1370	4480
Area C: Profit (above 10% rate of return on investment), federal income tax, and bonus payments.	220	3350	10900
Total	428	6510	21200

PRESENT VALUE*

	Min (5%)	Most Prob	Max (95%)
Area A: Consumer surplus	41	626	2040
Area B: Royalty	32	480	1570
Area C: Other surplus	77	1170	3820
Total	150	2280	7430

* Present value in 1979, using a discount rate of 10 percent, or a present value factor of .35.

e. Natural gas

Lease sale #48 could produce significant quantities of natural gas as well as oil (see Tables II.C.1 and 2). But the production of gas will be of secondary importance to oil in economic value and so will be considered in much less detail here. Also, the gas produced may be reinjected to keep up the well pressure and to aid oil extraction rather than produced for consumption.

The same cost calculations that were performed for oil, using ADL's minimum required price calculations, were performed for gas. See Figure II.C.5. for MRP(s) for natural gas. The result of these calculations was an average expected cost of about $.80/Mcf of gas.

What this gas will be worth is a much more complicated matter than it is for oil. The value of gas is much more subject to local supply and demand conditions, because of relatively higher transportation costs, and because there is much less chance for short-term shifts in the movement of gas to markets (pipelines vs. tankers). This and the structure of price controls on domestic gas cause there to exist simultaneously many different prices for natural gas in California. These vary from about $.50/Mcf for old "interstate" gas, including previously leased OCS, to $2 - $3 for gas piped in from Canada and Mexico. Even higher prices may be paid in the future for liquefied natural gas tankered in or for synthetic natural gas produced from coal, oil or biomass. These prices are averaged together ("rolled in") and face the consumer as a single price. This has the unfortunate effect that one can never really tell if the marginal consumer (who places the lowest value on gas) would be willing to pay for the marginal gas (that is produced at greatest cost). If he is not, the marginal gas should probably not be produced.

To do a detailed analysis of the value of gas from lease sale #48 is beyond the scope of this work. However, a reasonable estimate can be derived by a simple calculation.

On a thermal basis, 6 Mcf of gas is approximately equivalent to 1 barrel of oil, so that if burned in an industrial boiler as a substitute for fuel oil it should be worth on this basis alone about $2.33/Mcf (14/6). If the average cost is $.80/Mcf and the controlled price is $1.46/Mcf, then the benefits will be those given in Table II.C.4.

Table II.C.4

OCS Lease Sale #48 National Economic Benefits from Natural Gas Production

(Millions of 1975$)

TOTAL REVENUES

		Min	Prob	Max
A.	Consumers' Surplus ($2.33-1.46)xq	37	748	1712
B.	Royalty Payments ($1.46/6)xq	10	209	479
C.	Other Surplus ($1.46x5/6-$.80)	18	358	820
	Total	65	1320	3010

PRESENT VALUE

		Min	Prob	Max
A.	Consumers' Surplus ($2.33-1.46)xqx.35	13	262	599
B.	Royalty Payments ($1.46/6)xqx.35	4	73	168
C.	Other Surplus ($1.46x5/6-$.80)x.35	6	125	287
	Total	23	461	1050

* Present value in 1979, using a discount rate of 10 per cent, or a present value factor of .35.

f. California's Share of National Benefits

The people of California, as members of the nation, will share in the market-economic benefits presented in Tables II.C. 3 and 4. But it may not be readily apparent how these benefits get back to the people of California.

Those revenues from the lease sale which go to the federal government (royalties, bonuses, rents and taxes) may displace federal taxes, so that Californian's gain in the form of a decreased tax burden in proportion to their population (or possibly more accurately, in proportion to the state income) . If the federal revenues from lease sale #48 instead lead to greater federal spending, the amount of this increased federal spending which in some manner benefits California should still be proportional to the relative political power of the state, which again can be roughly approximated by its state population or income.

Profits from the lease sale will go to shareholders of the participating oil companies; or, if retained by those companies and invested elsewhere, will still presumably add to the value of their stock. That Californians hold at least their share of oil company stock is a reasonable first approximation.

Finally, a proportionate amount of consumer surplus from the oil produced will go to the consumers of California, even if, as is often argued (see discussion of the West Coast oil glut below), none of the oil is consumed in California. While it may have seemed natural to assume that the consumer surplus of Figure II.C.4. (area A) went to the consumer of that particular oil, the only way a consumer realizes any benefits from a new development is through its effect on the price of oil. Under the entitlement program, the price as seen by consumers of crude oil is the weighted average or composite of the $14 per barrel world price and the $11.50

per barrel domestic price - by displacing foreign crude with more lower priced domestic, OCS development will lead to a lower composite price for everyone. That the consumer surplus enjoyed by the nation from the change in composite price over all U.S. consumption of oil is the same as the consumer surplus of Figure II.C.4. can be shown by the following (for the simple assumption that OCS oil displaces foreign oil without changing total domestic consumption):

If χ is domestic production, y is foreign imports, q is lease sale #48 production, p_1 is the composite price without q and p_2 is the composite price with q, then

$$\text{consumer surplus} = (p_1 - p_2)\ (\chi + y)$$

$$= \left(\frac{11.5\chi + 14y}{\chi + y} - \frac{11.5(\chi + q) + 14(y-q)}{\chi + y}\right)(\chi+y)$$

$$= (14 - 11.5)q$$

which is area A of Figure II.C.4. This of course means that Californians will share in the benefits in proportion to their consumption of oil.

To see how this transfer of benefits actually takes place, suppose that all lease sale #48 oil is shipped out of California to the rest of the country, and that the proportion of domestic to foreign crude consumed by California is not changed by OCS development. The result of this is that producers in the rest of the country will have to buy more entitlements for their domestic crude from California producers, which will lead to a lower composite price in California.

Table II.C.5. gives California's share of national benefits assuming these are proportionate to California's share in national population (about 10%). The numbers here are derived from Tables II.C.3 and 4.

Consumer surplus from natural gas is the one exception to the 10% rule and is assumed to accrue entirely to California. As discussed above, the markets for natural gas are more local, and pricing is complex. These numbers should be regarded with some scepticism.

Table II.C.5

OCS Lease Sale #48

California's Share of National Economic Benefits
(Millions of 1975 $)

OIL

TOTAL REVENUES

		Min.	Prob.	Max.
A.	Consumers' Surplus	11.8	179	583
B.	Royalty Payments	9	137	448
C.	Other Surplus	22	335	1090
	Total	42.8	651	2120

PRESENT VALUE*

		Min.	Prob.	Max.
A.	Consumers' Surplus	4.1	63	204
B.	Royalty Payments	3.2	48	157
C.	Other Surplus	7.7	117	382
	Total	15.0	228	743

NATURAL GAS

TOTAL REVENUES

		Min.	Prob.	Max.
A.	Consumers' Surplus	37	748	1712
B.	Royalty Payments	1	21	48
C.	Other Surplus	2	36	82
	Total	40	805	1842

PRESENT VALUE*

		Min.	Prob.	Max.
A.	Consumers' Surplus	13	262	599
B.	Royalty Payments	.4	7	17
C.	Other Surplus	.6	13	29
	Total	14	282	645

* Discount factor = 0.35, corresponding to a rate of 10% per year, and given the production schedule of Table II.C.2.

4. Complicating Factors

Up to this point, the analysis has considered the costs and benefits of leasing in 1979 as currently scheduled. This was done using the present world oil price as the value of the oil produced for the entire life of the project. For this base case, there would never be any economic reason for delaying the lease, since any positive discount rate would lead to lower and lower present benefits as the lease is delayed.

There are two reasons why the value of this oil might change over time:

- An increase in the world price of oil, and
- A "glut" of oil on the West Coast which would depress the value of oil produced there by the cost of transporting it elsewhere.

If the decision of interest is whether to lease at all, the effects above are offsetting; but if the question is when to lease, both scenarios favor delay. An escalating world oil price would add to the benefits of the oil calculated in the preceding section, since the higher the world price, the more costly is the oil replaced by lease sale #48 production. A price-depressing glut would almost certainly subtract from these benefits. On the other hand, both a rising world oil price and a glut that eventually ends would increase the value of the oil in the future with respect to the present, and militate in favor of delay. Whether or not delay is actually beneficial will depend on how great the effects are and on the discount rate.

Since the Department of the Interior is the manager of publicly owned Outer Continental Shelf mineral resources, it is obliged to consider fully the benefits of delaying production. Oil companies generally hold leases in an undeveloped state for only a five-year period, and so cannot recoup any "capital gains" resulting from increases in the price of oil over a longer time period. These hypothetical gains would be lost if production commenced prematurely. Since producers are greatly discouraged by current regulations from delaying production for even the length of their five-year lease, it is incumbent on DOI to consider delay for the purpose of avoiding these losses. (Producers must start production in 5 years or lose the lease, but they can lose it earlier if they are not seen to be exercising "due diligence.")

a. The West Coast "Oil Glut"

While the value of world oil will increase in the future, the present and near-term value of oil in California is being depressed by a large surplus of oil. There are several reasons why there is a glut of oil on the West Coast despite the overall shortage (or at least a heavy dependence on imports) for the country as a whole. The most significant of these is the Trans-Alaska Pipeline System (TAPS), which is currently flooding the West Coast with about 1.2 million barrels per day of crude oil. Because of a restriction imposed by the federal government, this oil cannot be exported [15].

At the same time, there are technical reasons why the West Coast cannot greatly decrease its use of foreign oil. Refineries are designed to handle specific types of crude, which vary greatly in viscosity and sulfur content. Imported crudes (especially Indonesian) supply a light and low-sulfur component to mix with indigenous California crude, which is generally heavy and high in sulfur, and Alaskan crude, which is intermediate in weight and sulfur content between California crude and the high-grade imports.

Published estimates of the magnitude of the West Coast glut through 1985 are given in Table II.C.6. By all estimates, the surplus in 1985 will be above the peak expected production from lease sale #48. (The lowest estimate of 400 Mbbl/day is approximately double the peak production rate from lease sale #48 tracts.) Thus, all the oil from lease sale #48 tracts would contribute to the glut.

The effect of the glut is to depress prices on the West Coast. To see exactly why and how much prices will be depressed, consider what happens to the surplus oil. It will not replace much imported oil in California because of the technical constraints on refineries cited above. Most of the oil will be shipped to other places, bearing additional costs and competing at its destination at world prices. That means that its price in California must be the world oil price at the point of transshipment minus the cost of shipment. While the oil companies would like to keep the price on the West Coast up to the world oil price levels, they will be forced (in the face of competition) to sell at the lower price.

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[15] Trans-Alaska Pipeline Authorization Act of 1973 (PL 93-153, or 83 Stat. 584).

Exactly how much prices will be depressed is a complicated matter, depending on [16]:

(1) whether exports to Japan are finally allowed. (If they are, the price on the West Coast will be depressed only by about $.50/bbl., or enough to make selling the oil in Japan with increased shipping cost competitive with selling it in California.)

(2) whether the Sohio pipeline is built and the cost of transporting a barrel of oil through it. (Estimates of these costs range from $.87 to $1.56/bbl.)

(3) the cost of tankering oil through the Panama Canal, estimated at $1.34 to $1.65/bbl.

If some combination of these projects eventually becomes reality, the delivered price in California will presumably be driven down to be competitive with the next best alternatives.

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[16] Estimates below are from California Energy Resources Conservation and Development Commission, California Energy Trends and Choices, Vol.4: Fossil Fuel Supply Issues, Biennial Report of the State Energy Commission, 1977, p. 283.

Using an average price depression from above of \$1.20 per barrel, and assuming that the glut depresses the value a constant amount until it ends, the present value of the loss incurred by leasing as scheduled (1979) is given by:

$$\text{PV Loss} = \Sigma \frac{\text{Prod}(I)}{\text{Prod}} \frac{1}{(1+r)^I} \times \text{Prod} \times (\$1.20)$$

The results are (for 10 percent discount rate and the most probable total production of 715 million barrels):

Duration	Glut Ends	Million \$ PV Loss
6	1985	49
11	1990	230
16	1995	280
21	2000	300

The discussion above is intended to give some insight into the magnitude of the effect of the glut - to serve purposes of the present analysis. It is a very cursory look at a complex situation. Other factors, such as air pollution controls, restrict the ability of refiners to move from imported to domestic crudes. The costs and incentives for refiners to make such moves are not well known. Furthermore, in a dynamic situation over a long period of time, unforeseen shifts in the market are likely. But, as will be shown below in the sensitivity analysis, these uncertainties are not very important to the decision to lease (from the perspective of net national benefits.

Table II.C.6

FORECASTS OF WEST COAST (PADD V)* CRUDE OIL SURPLUS (Mbbl/day)

SOURCE	1978	1980	1982	1985
SOHIO	320-600	-	660-960	-
Exxon	552	697	-	1797
Rand (Med Use Med Prod)	320	-	-	751
A.D. Little (Best)	-	689	-	805-1395
Standard Oil Co. (California)	-	400-600	-	400-600
ARCO	300-400	500-600	-	850
FEA	500-600	900-1100	-	700-1300

Source: FEA and the California State Energy Commission.

*PADD V is an abbreviation for Petroleum Administration District for Defense V, the designation of an aggregation of western states used for reporting petroleum statistics by industry and the federal government (primarily the Bureau of Mines, Department of the Interior). The following states are included in PADD V: California, Arizona, Washington, Oregon, and Nevada.

b. Future World Oil Prices

World oil prices will almost certainly increase in real terms over the next 20 years. As already noted, this would mean that oil would be more valuable if produced at some later date. But whether this fact actually justifies delaying the lease sale depends on how much prices are expected to rise, what the range of uncertainty is over this price rise, and the nation's time preferences regarding current versus future consumption.

A recent study by Arthur D. Little, Inc., gives that group's subjective probability estimates for world oil prices through the year 2000 [17]. Their study utilized a Delphi technique, which is simply a method of guiding a group of experts toward reaching a consensus. The expected value of their assessment is a 3.6 percent per year increase through 1990. Again finding the present value of a stream of future cash flows:

$$\text{PV Gain} = \Sigma \frac{\text{Prod(I)}}{\text{Prod}} \; \frac{(1+\text{RlWOP})^{I}}{(1+r)^{I}} \text{ x Prod x (\$14-\$4.90)}$$

where RlWOP = rate of increase of world oil prices. This calculation gives a present value of $3.83 billion. Subtracting the base case benefits of $2.33 billion leaves $1.5 billion expected increase from rising world oil prices.

By combining the adverse effect of the West Coast oil glut (a $1.20/bbl loss of value due to transportation costs) and the positive effect of rising world oil prices (at 3.6% yearly in real terms over the life of the tracts), a net gain relative to the base case is obtained of $1.3 billion. This gives a total expected value from the lease sale of $2.33 + $1.30 billion, or $3.63 billion.

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[17] Arthur D. Little, Inc., World Crude Oil Price Outlook, 1977, 17 pages.

Notice that this analysis is:

(1) Deterministic, (uncertainty has been ignored by using mean values for uncertain variables.)

(2) Based on leasing as scheduled in 1979 only,

(3) Based on a discount rate of 10 percent, world oil price increasing at a steady rate of 3.6 per cent, a $1.20 per barrel price depression from the glut, a resource base of 715 barrels, and constant average cost of $4.90 per barrel.

The next sections will consider the uncertainty in the effects of the glut and world oil prices, as well as the effects of delaying the lease sale.

c. Sensitivity Analysis

Because the variables which will affect the decision to delay (world oil prices and the effects of the glut) are highly uncertain it will be necessary to take proper account of this uncertainty. One method for treating uncertainty is a sensitivity analysis, which involves varying the values of the uncertain variables to see if the result of interest (in this case the present value of the total social surplus) is "sensitive" to these changes. In a policy analysis context, the more important question is: Is the decision sensitive to the uncertain variable? If not, the variable in question may be set to its expected or most probable value for the rest of the analysis, while those uncertain variables to which the decision is sensitive can be modeled in greater detail.

The other method is to incorporate uncertainty directly into the model through the use of probability functions. Usually, a sensitivity analysis is performed first, and then subjective probability functions are encoded for those variables to which the decision is sensitive.

The sensitivity analysis method used here is that described above, except that, instead of simply computing total social surplus for each set of variables, computations were made of breakeven points, i.e., points for which delay and no-delay yield equal social profit.

Some of the results of this exercise are shown in Figures II.C.7 and 8. Figure II.C.7 shows that, at a discount rate of 10 percent per year, the decision to lease now or later is not sensitive to the glut. For each of the four curves in this figure, the area above the curves describes those values for which it is better to delay leasing at least until the year corresponding to the curve, while the area below describes those conditions (values of average growth in world prices after 1979 and for depression of price by the glut) for which it is better to lease earlier. Each curve corresponds to a fortuitious timing of the lease sale six years before the glut ends, bringing a rise in value just in time for the peak production volumes from the OCS. This fortuitious timing should give close to the maximum effect from a glut. Despite this, only the extreme case of a very short delay (1 year) and a large price depression (above $2) from a glut breaks even at less than a 7 percent growth rate (which is still very high -- see Table II.C.5 below).

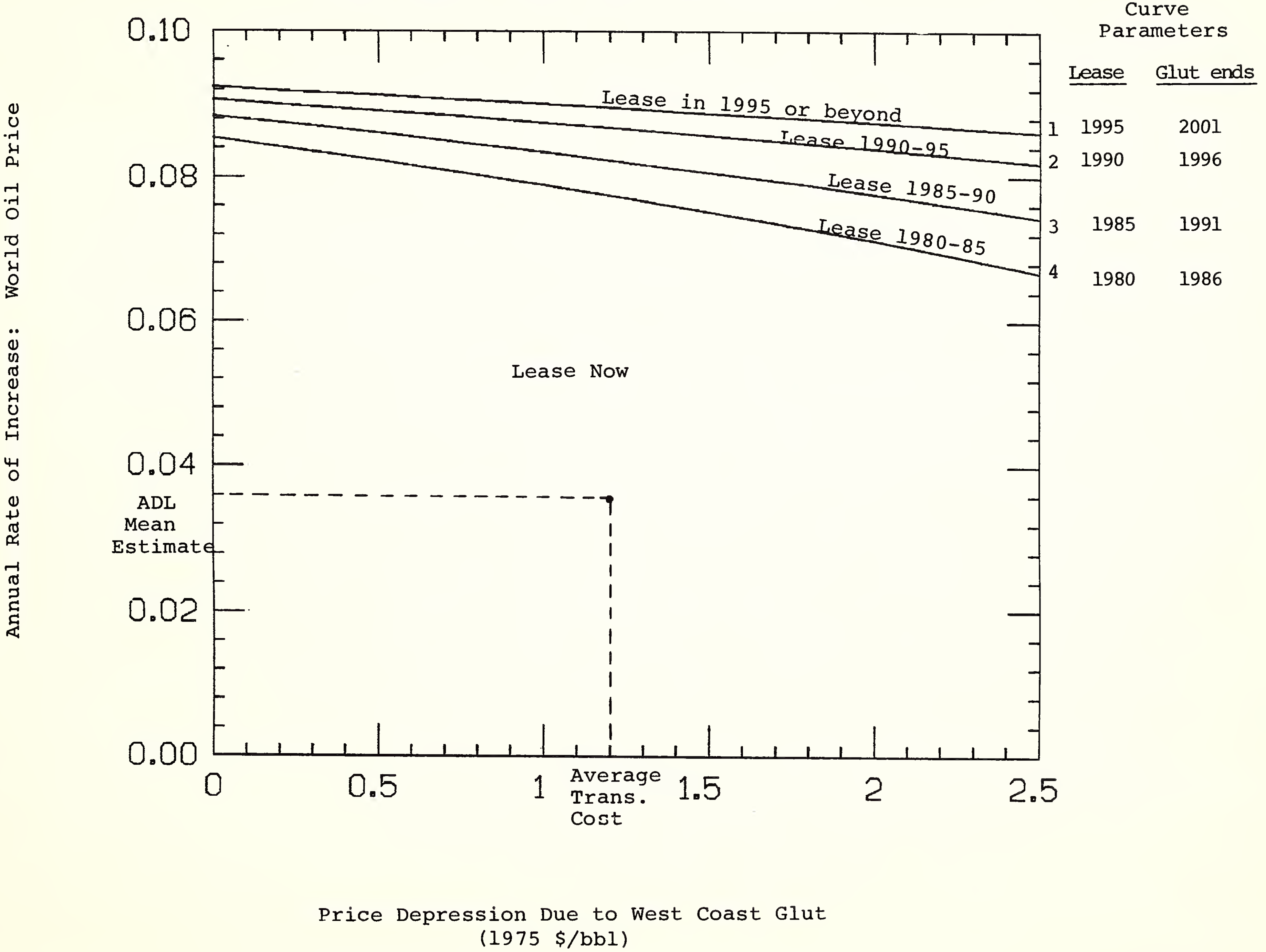
The reason for this lack of effect in the later years is simply that, at the 10 percent discount rate, the present value of $2 in 2001 is very low and makes little difference now. On the other hand, the reason for the lack of a bigger effect in the earlier years is the overlap of production -- for the case of a 1980 lease, only one year's production relative to leasing in 1979 gains the advantage of price differential created by the glut. That the results are not sensitive to the glut parameters does not mean that these parameters can be ignored; rather, they can be fixed at their expected values while attention is turned to other effects.

One parameter to which the decision to delay really is sensitive is the discount rate, as can be seen in Figure II.C.8. This figure is based on an end-of-glut in 1993, leasing in 1990, and a glut-induced price depression of $1.20. For these conditions, the difference in the breakeven rate for world oil price growth more than doubles from 3.5 percent (approximately the expected) to 8.0 percent (very unlikely over a long period of time), depending on whether a 5 percent or a 10 percent discount factor is applied. Thus the discount rate should be chosen carefully.

Notice that, at the expected rate of increase of world oil prices of 3.6 percent, the breakeven discount rate is

Figure II.C.7

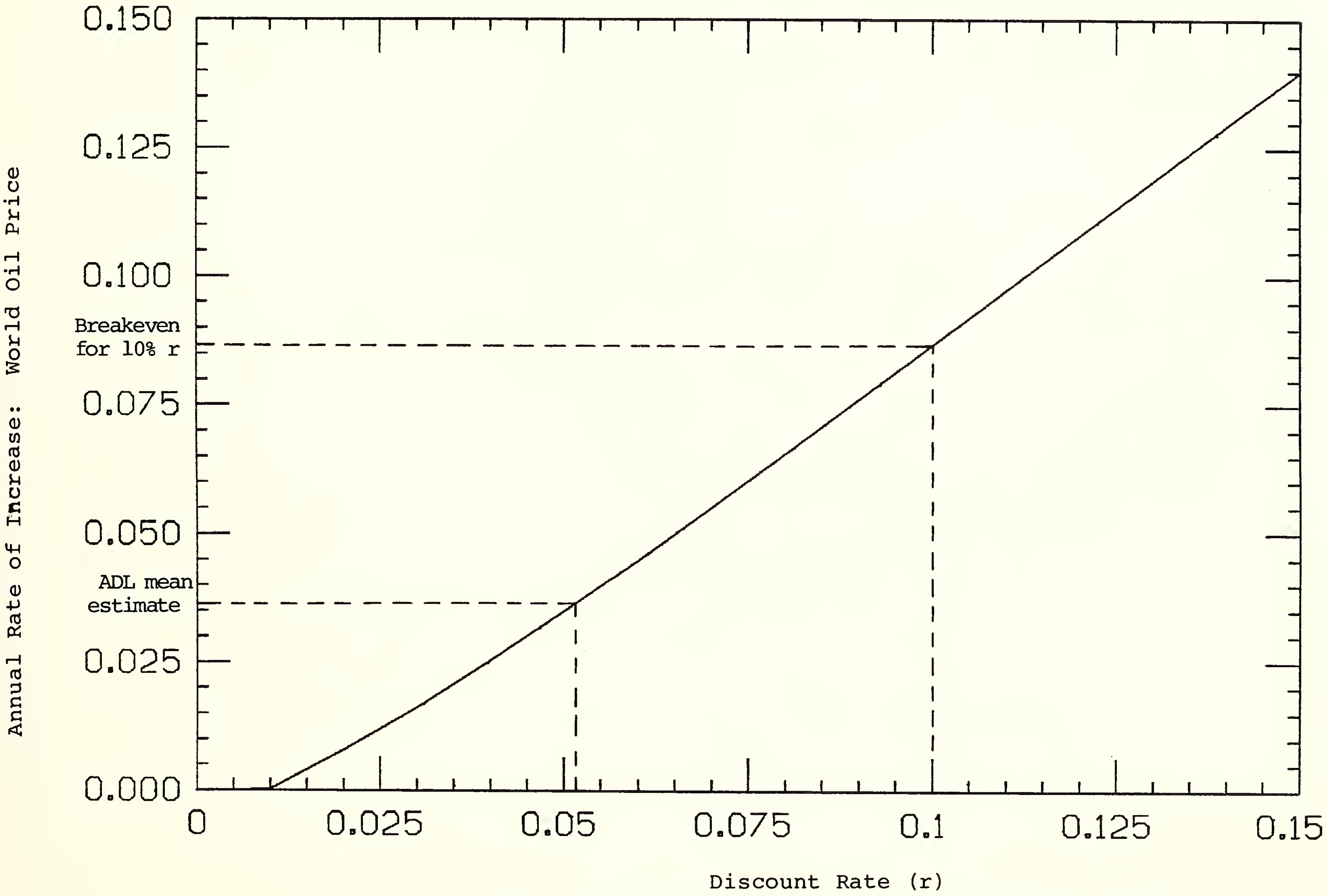
West Coast Oil Glut Sensitivity Analysis



about 6 percent. At the 10 percent discount rate assumed for all previous calculations, the breakeven rate for world oil price increases is above 8 percent.

Figure II.C.8

Sensitivity of Decision to Lease to Increasing
World Oil Prices and Discount Rates: Breakeven Values



Assumes that glut depresses price $1.20 and ends in 1985.

d. Incorporating Uncertainty

Already it is apparent that, at a 10 percent discount rate, the decision to lease now or delay is not sensitive to either increasing world oil prices or the glut.

However, since a recent study by ADL [18] developed a subjective probability distribution for future world oil prices, it is easy to explore the consequences of this distribution for offshore leasing. The next step is to incorporate uncertainty directly into the preceding analysis in the form of a subjective probability function.

Table II.C.7

World Crude Oil Price Outlook

Rate of Smooth Growth Average Growth Rate (RIWOP)	Probability thru 1990
-4.0%/year	2%
0. %/year	15%
2.5%/year	31%
4.5%/year	27%
6.1%/year	15%
7.5%/year	7%
8.7%/year	3%
Median growth rate thru 1990	3.9%/year
Mean growth rate thru 1990	3.6%/year

Source: Arthur D. Little, Inc.

The way this will be done is to find the expected value (or probability mean or average) of the results by taking a value of the parameter (in this case the average rate of price increase), determining the results of using that parameter in the model, and then multiplying the result by the

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[18] Ibid.

the probability of that parameter value occurring. The values are summed over the entire range of such parameters. In mathematical notation, this is:

$$\text{Expected Value} = \sum_{I} \text{Prob}(I)\ \text{Result}(I).$$

The options of particular concern to this section are the initiation of leasing of the tracts in lease sale #48 between 1979 and 1990. These options can be structured simply as:

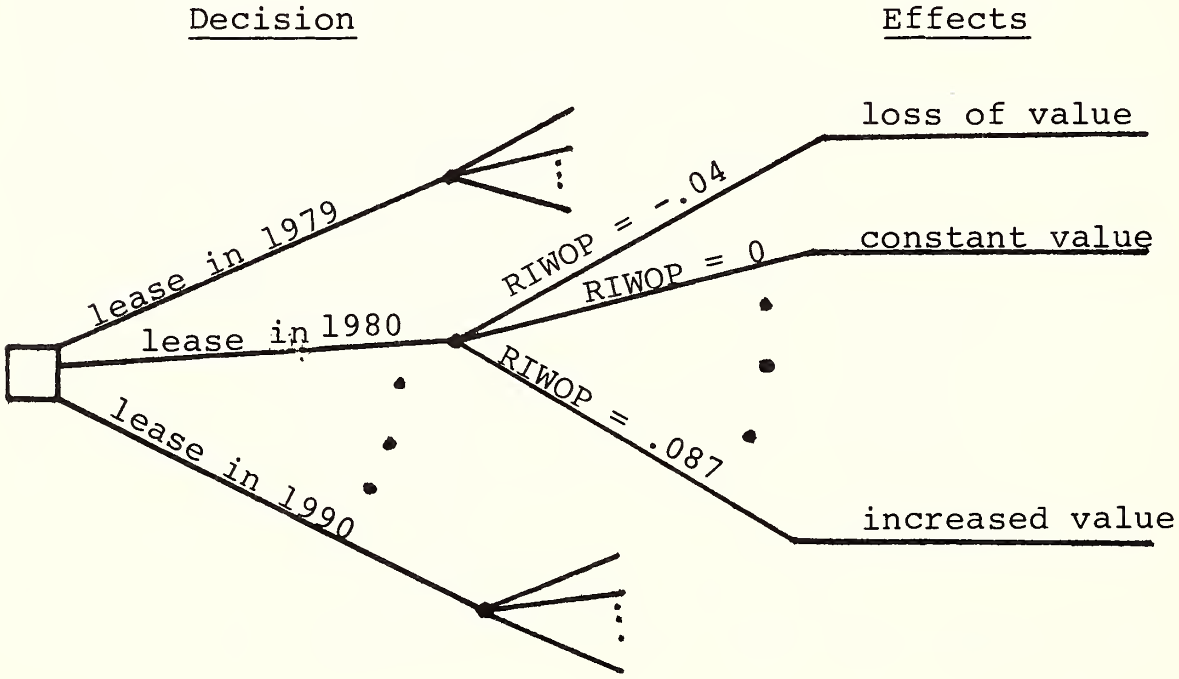


Figure II.C.9.

Incorporating Uncertainty

where RIWOP is the rate of increase of world oil prices from Table II.C.7.

Using such a model, Figures II.C.10,11, and 12 were constructed showing the present value of the expected social surplus in dollars for leases initiated in different years.

Figure II.C.10 shows expected discounted net benefits as a function of delay for given discount rates. Note that, for discount rates of less than 6 percent, these benefits increase with delay, while for greater than 6 percent they decrease. At 6 percent the curve is almost flat, implying relative indifference to when leasing takes place.

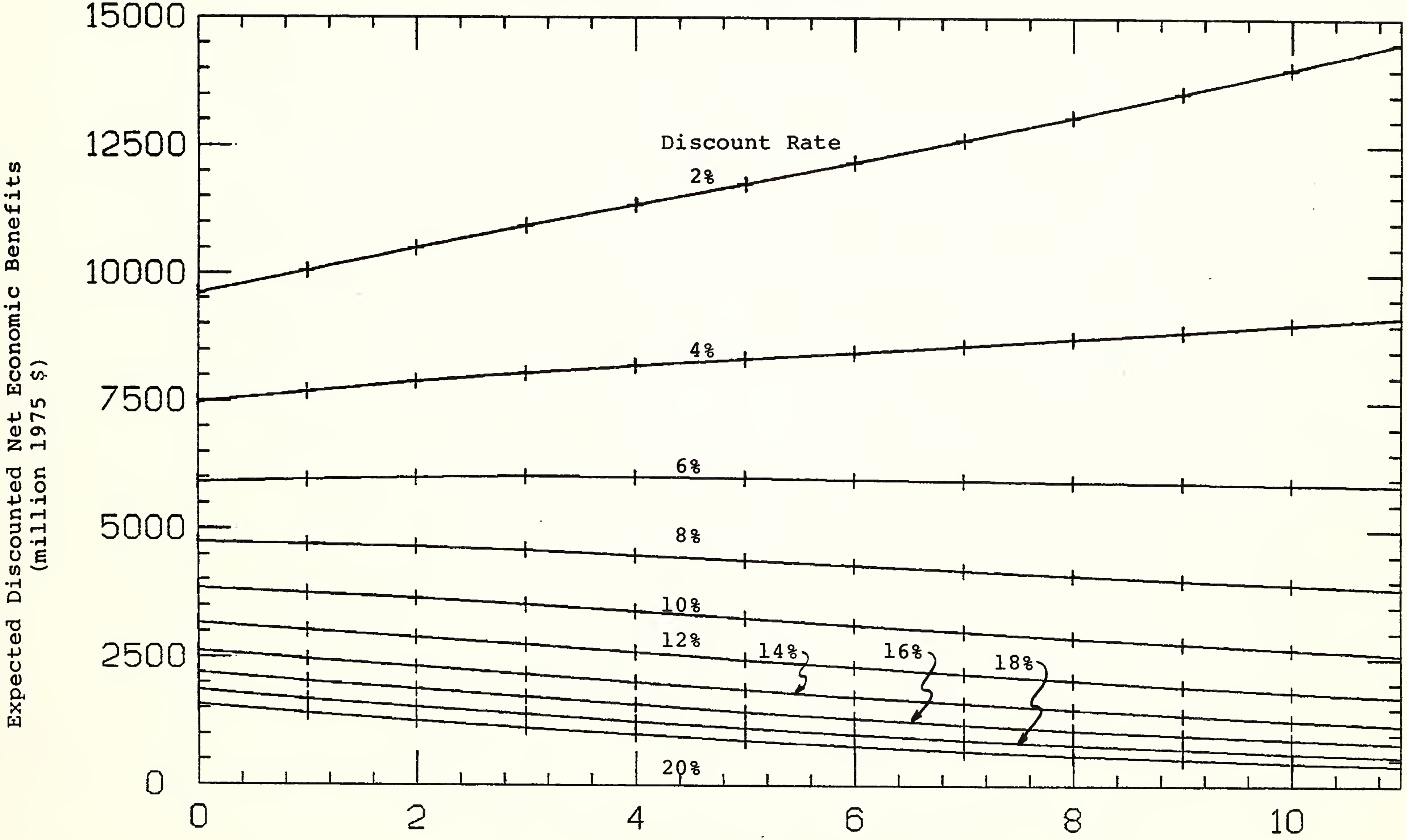
Figure II.C.11 graphs the same points as the preceding figure only the roles of the discount rate and the years delay have been reversed, i.e., expected discounted benefits are now functions of the discount rate along lines of constant delay. Note that the curves all pass through roughly the same point (at about 6 percent). Below this point, lines of greater delay are always above those of lesser delay. Beyond 6 percent the reverse is true, leading to the same conclusions as above. (The fact that all the curves run through the same point is interesting. The rate of growth of world oil prices and the interest rate both lead to geometric growth in expected benefits; but the effect of the glut is not geometric. That all the curves run through the same point indicates that the effect of the glut is very small.)

Figure II.C.12 is an "excess probability distribution" on benefits derived from the distribution on price growth. An excess distribution (the opposite of cumulative distribution) gives the probability that the random variable (in this case expected discounted benefits) is greater than a certain value -- thus at 0 the value is 1 for all curves since it is certain (the probability is 1) that net economic benefits will be greater than 0.

Note that in Figure II.C.12, the curve for leasing now lies completely above the other curves, and is therefore said to stochastically dominate the other alternatives.

Figure II.C.10

Benefits of Lease Sale #48 as a Function of Sale Delay for Various Discount Rates*



*For assumptions see note in Figure II.C.11.

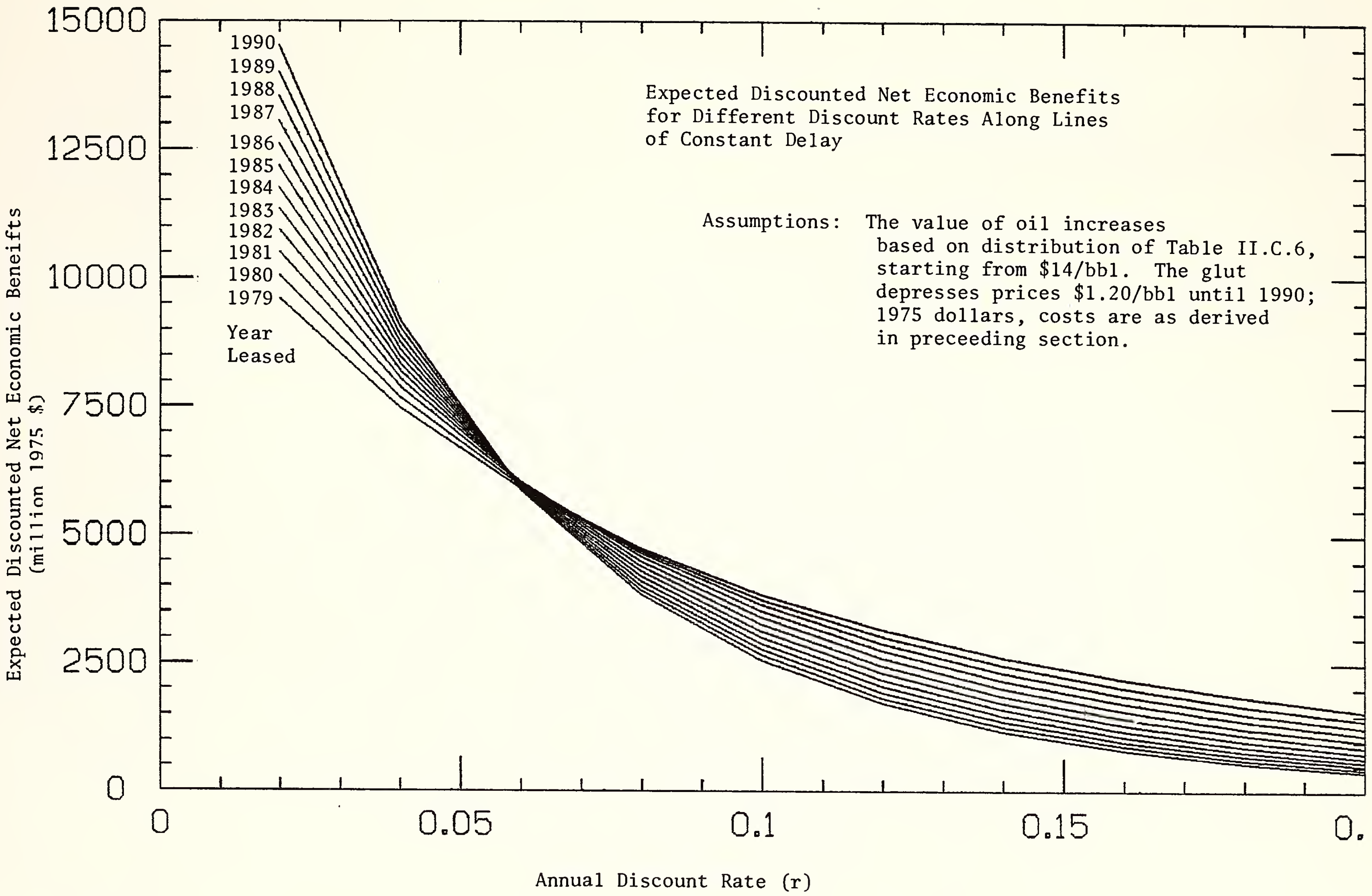
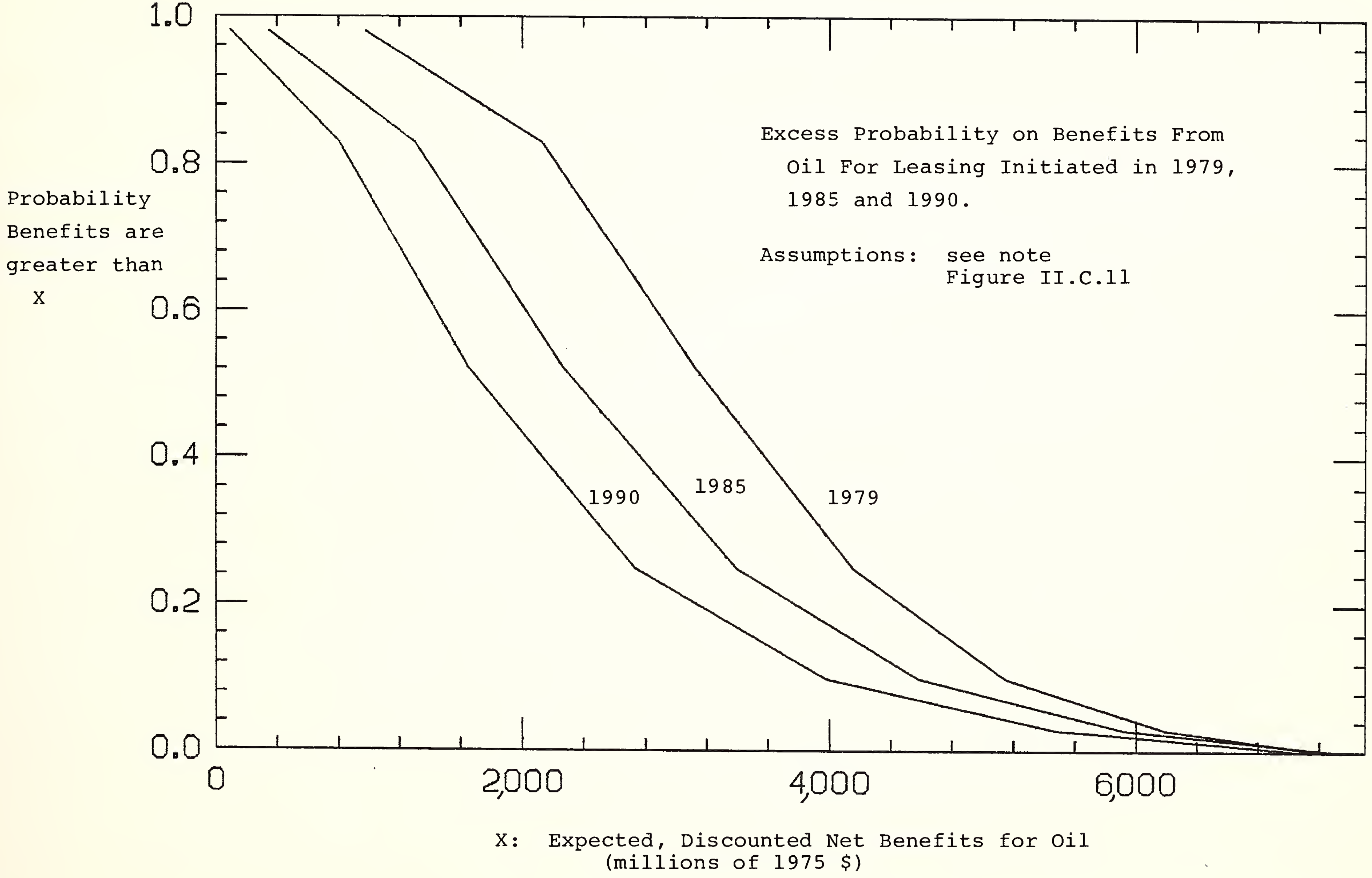


Figure II.C.11

Figure II.C.12



Excess Probability on Benefits From Oil For Leasing Initiated in 1979, 1985 and 1990.

Assumptions: see note Figure II.C.11

In summary, although both the glut and rising world oil prices will have significant effects on the total value of lease sale #48 development, they should have little effect on the decision to lease in 1979. This conclusion is based on an assumption of a 10 percent per annum social discount rate - if policy-makers choose to use a discount rate below 6 percent delay of leasing is indicated, even from a national perspective.

The next section will look at non-market-economic costs and benefits - mostly air and water pollution - from lease sale #48 development to see what extent these alter the conclusions derived from the existence of large market-economic benefits.

D. External Impacts of Oil and Gas Production from Lease Sale #48

1. Introduction and Summary

The direct economic benefits of oil and gas production from lease sale #48 were calculated in the preceding section and the sensitivity of net benefits to changing world oil prices, the West Coast oil glut, and discount rates examined. These impacts are said to be direct because the social surplus is calaculted with reference to the markets for crude oil and natural gas, as if these products were the only effects of offshore oil and gas activities.

But obviously, there are a variety of indirect, external, or secondary effects that can be anticipated from lease sale #48 operations [1]. These effects (notably air pollution and oil spills) generally have negative value, are imposed on the population living near the productive activities, and given the assignment of authorities to levels of the federal system, are the fundamental source of conflict regarding development proposals for offshore oil and gas.

Unfortunately, the elimination of the real sources of conflict is hampered by a philosophical gap between the principals - one which perpetuates adversary roles. Many developers and agencies within the federal government would, for rather transparent reasons, prefer that offshore development proceed upon a determination of net national benefits. In the extreme, this attitude ignores distributional considerations and amounts to ignoring the external costs analyzed in this section. As discussed elsewhere in this Study, we believe that the low cost of localized external effects relative to national direct benefits provides the opportunity for redistributions from developers and the federal government to local citizens and governments which will make all the principals better off than if the net national benefit proposal were rejected.

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[1] For a fuller discussion, see section I.A.

The purpose of this section is to calculate the distribution of secondary effects of greatest concern to state and local officials and to value these effects such that they can be compared with direct economic benefits and serve as a starting point for redistribution negotiations. The remainder of this introductory subsection is devoted to an overview of the techniques employed, and summaries of the amount and distribution of external costs.

a. Methods and Assumptions

Of the variety of effects that could conceivably be associated with lease sale #48 activities, only those due to air pollutant emissions and oil spills are analyzed herein. Two other effects of concern to state and local officials, namely local economic effects and the increased risk of vessel collisions, appear to be strongly dominated by the air quality and oil spill issues.

For both effects, costs are determined by estimating actual damages rather than by assessing probabilities or counting instances of violating standards or laws. This route has been chosen because it allows comparison with direct economic benefits, suggests redistributions, and permits evaluation of the effects of laws and standards. While this approach has many advantages, it is unfortunately somewhat divorced from the concerns of officials charged with enforcing laws - officials without the luxury of questioning if current laws do in fact yield desired results.

Another approach compatible with the preceding direct economic analysis involves estimating the cost of removing the sources of damages - of cleaning up emissions and spilled oil. For the case of air emissions, these costs are not considered because to substitute them for damage costs implies that clean-up activities will in fact occur (this linkage is not yet part of the lease sale decision and cannot be inferred from the Clean Air Act) and that clean-up costs are less than damage costs (otherwise clean-up actitivies should not be undertaken). Since federal law mandates that responsible parties contain and clean up spilled oil (regardless of damage versus clean-up costs), we do include clean-up costs in oil spill damage estimates. Only a portion of the oil is cleaned up for major oil spills, and so a cost estimate based on these costs alone would seriously underestimate the actual damages.

The bulk of the analysis of this section is directed toward air emission effects and effects on health in particular. The model used to estimate air pollutant induced damages to materials, residential property and vegetation is quite simple, as is the oil spill model.

Two sorts of calculations are made with the air quality effects models - the deterministic and expected value/ probabilistic. The deterministic calculations correspond to best, worst, and "most likely" cases. The most likely case is referred to as a point estimate and results from using the most likely or published parameter values in the model. In the last subsection, probability distributions over the model parameters are assumed and introduced, which are skewed toward high values of the model parameters (whose means exceed their medians). As a result of the distributions assumed, the probabilistically derived expected costs of air pollution exceed (by roughly 50%) the deterministically derived "most likely" costs. The expected costs are cited in this summary and in the executive summary of the demonstration, while the point estimates are shown in parantheses beneath the ranges in most of the tables in the air pollution section following.

The first step in estimating air quality impacts from lease sale #48 activities is that of estimating emissions over the productive life of the tracts. As is common practice, aggregate emission rates are determined by summing the emission rates associated with each of the separate phases of production. Emission rates are expressed in terms of the flow of oil and gas through a particular phase, and are based on published data. Uncertainty regarding the actual production processes to be employed is not incorporated into the analysis by the usual scenario approach, but rather by constructing and extremizing an oil and gas production network. This procedure results in ranges for emissions rates corresponding to best and worst cases. The network approach is amenable to computer calculation and can be easily updated as information improves.

Material and vegetation damages are calculated by assuming that damages are proportional to emissions and by using EPA data on damages and emissions. While it is recognized that this approach is extremely simplistic, resource constraints, combined with the lack of more sophisticated, compatible data and techniques led us to select this method as the only feasible way of obtaining some dollar estimate on these costs.

Many additional steps are needed to move from emissions to health damages. The second step is that of relating emission increments to concentration increases. Although more sophisticated spatially indexed models are in common use, we employ a region-wide "roll-back" technique which supresses spatial variations. The "roll-back" technique is selected not only for reasons of simplicity but also because the absence of accurate information on the spatial distribution of population, materials, and vegetation greatly reduces the value of accurate information on spatial variations in concentrations.

The next step is that of moving from area-wide average concentation increases to increases in health effects. The health effects considered are premature death due to carbon monoxide and sulphates, aggrevated heart and lung disease due to sulphates and oxidants, and asthma attacks due to sulphates and oxidants. These effects are all relatively serious and short-term. Long-term effects were not considered because of the lack of good data on dose-response relationships. Minor short-term effects such as headaches and eye irritation were also not considered. The effect of these deletions is to underestimate the health cost of lease sale #48 emissions. On the other hand, this tendency is mitigated and perhaps reversed by the assumptions discussed below which tend to overestimate health costs.

Health effects are assumed to occur only when ambient concentrations exceed critical medically derived thresholds for a specified duration. These thresholds are not the same as standards, but one hopes standards are set with reference to these thresholds. The fraction of time during which thresholds are exceeded depends almost entirely on the level of emissions from other background sources, in light of the incremental nature of lease sale #48 emissions. This property is embodied in the critical exposure fractions which are calculated and based on California Air Resources Board Monitoring station data, and which must be specified for each pollutant and health effect under consideration.

The critical exposure fractions are calculated with respect to Los Angeles, Ventura, and Orange County ambient concentrations, which by far exceed ambient levels in the other counties of the air basins of concern, namely the South Central Coast, South Coast and the San Diego. The effect of this assumption is to overstate health costs by as much as 40%. Furthermore, the critical exposure fractions are calculated with respect to 1975 data. Since these fractions are used over the life of production, this assumption overestimates health effects in proportion to the success of air quality regulators in improving ambient levels relative to 1975.

At any rate, given that ambient levels are in excess of thresholds, increases in health effects are calculated via dose-response multipliers on the base incident rate of health effects of concern. Finally, the National Academy of Sciences has published estimates of the social cost of these effects, which are used for the purposes of the point estimates and expected costs. While the NAS data is useful as a reference, any individual may, of course, value health effects as he chooses.

The oil spill damage model calculates the cost of major oil spills during the course of lease sale #48 operations by comparing them with the costs of the 1969 Santa Barbara Channel blowout. This procedure overestimates costs to the extent that the Santa Barbara spill was nearer to shore, larger, and of longer duration than the expected average major lease sale #48 spill.

b. Cost Summaries and Discussion

The expected costs of air pollution and oil spills during the course of oil and gas operations for lease sale #48, for various discount rates are summarized below:

Table II.D.1

Expected Total Costs of Lease Sale #48

Air Pollution and Oil Spills
(millions of 1978 dollars)

	Discount Factor			
	r=0.00	r=0.05	r=0.10	r=0.15
Air Pollution	37.8	22.7	14.7	10.1
Oil Spills	71.5	42.9	27.9	19.3
Total	109.3	65.6	42.6	29.4

Of the air pollution costs, oil production will account for nearly 70% of the damages with gas production accounting for the remainder. Less than 1% of the air pollution damages will be on vegetation. Health costs will account for nearly 60% of air pollution damages, with damages to materials and residential property accounting for the remainder.

In terms of pollutants, sulphates will account for 42% of the damages, smog inducing reactive hydrocarbons - 41%,[2.] nitrous oxides - 13%, suspended particulates - 4%. Damages due to carbon monoxide emissions will be relatively insignificant.

[2.] State and local authorities seem more concerned over hydrocarbon emissions than sulphur oxide emissions, despite the finding herein that the latter cause slightly greater damage. This oddity may derive from their substituting for the fundamental objective of bringing about the optimal pollutant concentration levels, the operational objective of minimizing the likelihood of violating standards. From a damage perspective, oxidant standards appear relatively strict and SO_x standards appear relatively lax.

The simple model of oil spill damages used herein implies that these damages dominate air pollution costs by a factor of almost two. However, and in contrast to the air pollution damages, only about 1/3 of these damages will be inflicted on local residents without compensation. The remainder (comprising clean-up costs, legal settlements, and the value of lost oil) will be absorbed by the responsible parties, petroleum consumers, and the tax-paying public.

Measured per unit of production, oil spills will cost a total of $.100/bbl; oil-induced air pollution damage will cost $.036/bbl; and gas-induced air pollution damage will cost $.014/mcf. In comparison with present world oil prices of about $14.00/bbl and gas prices of $2.50-4.00/mcf, these costs are very small. These figures are presented not to suggest ignoring the costs of Table II.D.1, but rather to point out the potential for and apparent ease of accomplishing suitable redistributions.

As is often noted, the greatest potential for minimizing these damages lies on the construction of pipelines for the transportation of crude to processing facilities and refineries. Although beyond the scope of this demonstration, it would be useful to determine whether the additional cost of constructing pipelines (for use with both lease sale #48 and #35 operations) relative to tanker and barge transportation, exceeds the figures cited above.

If pipelines are not constructed, then marine transportation is necessary. It is in the interest of local residents to minimize the amount of marine transportation in order to reduce hydrocarbon and sulphate emissions associated with loading operations and fuel burning, and to minimize the likelihood of oil spills and vessel collisions due to increased traffic density. This suggests that a systematic view of production operations be adopted and used as a guide in the evaluation of permit applications for isolated elements of the production processes.

Were the lease sale not held,some air pollution and oil spill damages would accrue to southern California to the extent that additional marine transported crude from other sources was necessary for California refinery consumption. Even if the substitution were one for one, damages would be lower because risks from production and processing would be borne elsewhere. However, California demand for lease sale #48 crude is expected to be weak, at least through the 1990's, due to the expected high viscosity and sulphur content of the offshore crude and the abundance of similarly constituted Alaskan oil already available to the West Coast. Thus, the likelihood of significant substitution is small and consequently the damages cited above do approximate the difference between the alternatives of leasing and not leasing.

Finally, several comments on the policy implications of damages estimates cited above can be made. First, note that the estimates are highly uncertain, and although improvements could be made via a more detailed analysis and the extensive use of appropriate experts, considerable uncertainty will inevitably remain. We conjecture that, although actual damages could be seven times greater than those cited, it is very unlikely that they would be more than double. Risk aversion on the part of local residents and their governmental officials suggests that actual redistributions should exceed the expected costs cited above, perhaps by a factor as great as two. [3].

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[3] Risk attitudes are reviewed in Volume 3 of this study. To illustrate, suppose that an individual faces a lottery with an expected cost of $1000 - a 10% chance of losing $10,000 and a 90% chance of losing nothing. If he would accept no less than $2000 to bear the risks of this lottery, then his risk factor for this lottery is two.

Second, it must be emphasized that the uncompensated air pollution and oil spill damages are imposed on residents of the three air basins, and individuals whose residences are near the coast or whose livelihood is coastal dependent. Were the total air pollution damages (discounted at 10%), distributed to each of the current residents of the three air basins, as the pure economic theory suggests, then the average payment would be just over $1.00.

Since this transfer is insignificant relative to residents' income and since it is also very impractical, actual transfers, if made, will probably be from developers and the federal government to or in accordance with the wishes of relevant agencies in state and local government (e.g., the Sohio pipeline and terminal transfers - see the following case study).

If the funds are used for offset or mitigation measures, then the substitution of transfers to individuals for transfers to agencies is appropriate only if the cost of offset measures is less than or equal to the damages that would occur if the measures were not taken. That is, mitigation measures should be ranked according to the elimination cost - damage cost ratio, and transferred funds should be used to carry out measures in sequence according to the ranking, ending with measures whose ratio is less than one. [4] Any excess funds should be saved or spent on other unrelated cost effective public works of benefit to the affected populace.

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[4] Note that these comments follow from an offset policy on costs and benefits, rather than an offset policy on pollutants proper, as embodied in the Clean Air Act.

2. Air Quality

a. Introduction

The purpose of this subsection is to present a simple yet complete method for predicting and evaluating damages to health, materials, and vegetation due to emissions from lease sale #48 oil and gas operations. Although these costs are very small relative to net national economic benefits, they are imposed solely on the residents of southern California. Thus the uneven distribution of costs and benefits, so typical of energy facility siting controversies, again has the effect of inducing conflict between a coalition of state and local authorities and one composed of federal resource agencies and offshore developers.

Oil and gas operations on lease sale #48 tracts will inevitably result in emissions of sulphur oxides (SO_x), carbon monoxide (CO), reactive hydrocarbons (RHC), nitrous oxides (NO_x), and suspended particulates (TSP).

Sulphur dioxide (SO_2) is produced with the combustion of fuel in amounts which vary with the sulphur (S) content of the fuel. Once in the atmosphere, SO_2 undergoes a chemical reaction, depending in a complex way on a variety of environmental factors, which yields sulphates (SO_4) and sulphuric acid (H_2SO_4). Significant damages can result from the contact of these products in sufficient concentrations, with both organic and inorganic materials.

Carbon monoxide is non-reactive yet has the potential of causing death to humans in sufficient concentrations. CO has no reported significant effects of vegetation and materials at ambient concentrations.

Reactive hydrocarbons and nitrous oxides combine in a very complex manner to form oxidants,(notably ozone O_3). These substances, along with TSP, are also reported to cause significant damages to health, materials, and vegetation.

Because of the simplicity of the model employed, particular types of damage to materials and vegetation are not specified. The data used purports to include aesthetic damages and considers corrosion, discoloration, structural weakening, and increased maintenance costs for materials and reduced growth rates for vegetation.

The health effects category includes premature death due to sulphates and carbon monoxide, aggravation of heart and lung diseases due to sulphates and oxidants, and asthma attacks due to sulphates and oxidants. These effects are all short-term and relatively serious. Longer-term effects are not considered because of the absence of compatible and reliable data and because of the contribution of lease sale #48 to such effects is not at all clear. Minor short-term effects such as the possible increased incidence of eye irritation and headaches are also not considered. Consequently, the ranges and point estimates given for health effects may understate the aggregate impact on human health. Nevertheless, the values given provide a benchmark for estimation of the aggregate.

i. The Social Cost of Air Pollution

The air quality analysis of the Draft Environmental Impact Statement for lease sale #48 has been severely criticized by local agencies [5.]. Consistent with their legal responsibilities, these agencies express great concern over the contribution of lease sale #48 toward increasing the likelihood of violations of the Clean Air Act, as amended.

[5.] Letters from Albert F. Reynolds, Acting Director, County of Santa Barbara Department of Environmental Resources to Mr. Peter Tweet of the Department of the Interior and Mr. Bill Grant of the Bureau of Land Management, both on 28 Feb. 78.

The Act prescribes the imposition of sanctions for violations, and local and state air quality regulators would obviously prefer to avoid such penalties.

Our criticism of lease sale #48 analysis is based on a different notion of what constitutes good public policy and associated analyses. Specifically, it is good public policy to permit the siting of a facility which is in the national interest - and a facility is in the national interest if and only if its effects are, or are redistributed, such that each party with effective veto power finds the facility in its interest. As noted in Volumes 1 and 3 of this Study, facilities in the national interest must have net national benefits. If this condition is met, then negotiations between principals regarding redistributions (in the form of direct compensation, offsets, stipulations to permits, etc.) must still, in general, be carried out in order that each party be confident that the final outcome is in its interest.

Our problems with the air quality analyses conducted to date are that actual damages or costs are not estimated. Since the emphasis is on complying with a law expressed in terms of pollutant concentrations, the analysis ends with concentration data. But apart from the increased likelihood of violating some standard, what are the actual social costs of incremental pollutant emissions?

There are two distinct ways of estimating the social cost of incremental air pollution. The direct approach estimates actual damages to health, materials, and vegetation, while the indirect approach estimates the cost of eliminating incremental pollutant emissions. The relationship between these two techniques is shown in Figure II.D.l.

In the figure at the top, the curve labelled MC_D represents the actual marginal damage caused by a concentration increment. The s-shape of the curve reflects the fact that incremental damages are small at low concentration levels, then rise almost linearly at moderate levels, and finally level off somewhat at very high levels. The curve labelled MC_E represents the marginal cost of reducing the ambient concentration by one unit. It declines steadily to reflect the fact that clean-up costs are high at low concentration levels due to technical problems and that at high concentrations, inexpensive measures can be very effective.

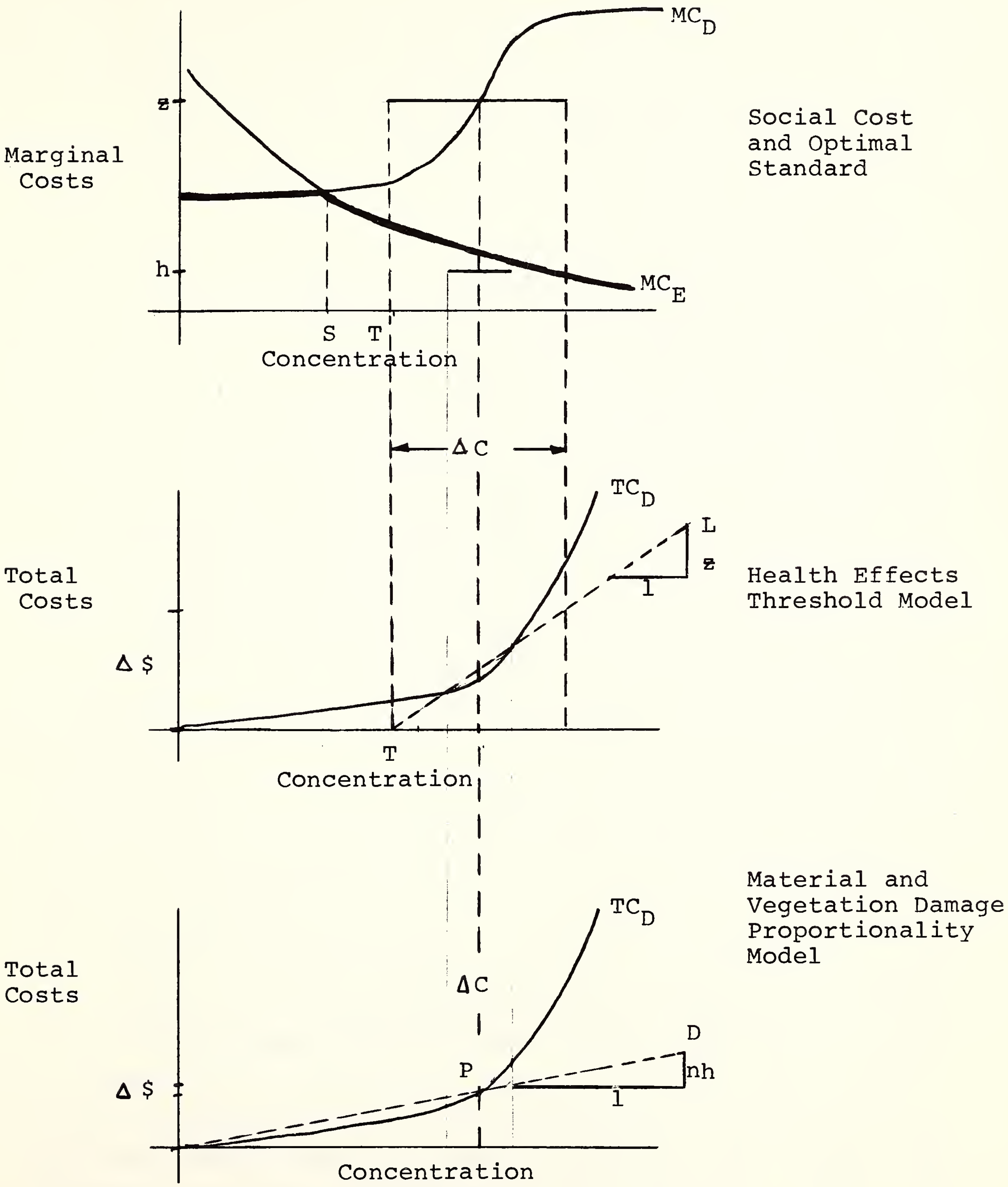
The true marginal social cost of concentration increments is shown by the dark line - being everywhere the minimum of the two curves. To see this, note that if the ambient concentration is to the left of point S, then the cost to society is given by the MC_D curve. The elimination cost exceeds the damage cost and so no elimination activities should occur. To the right of point S, the damage cost exceeds the cost of elimination and so it is in society's interest to clean up emissions until concentrations are at point S again. Clean-up operations yield a benefit to society and the operator equal to the area difference between the two curves. Yet the cost of elimination remains as a social cost. Note finally that the actual social cost is independent of what particular standards are chosen.

The point s represents the maximum level of pollutant concentration that would occur in a centrally planned economy. Actual levels could be less if there were fewer sources emitting pollutants. Thus the optimal concentration level is between zero and S. S also represents the optimal regulatory standard for the purpose of initiating an inviable area-wide one to one pollutant offset policy. We hope that the multitude of detailed regulations now in force are directed toward bringing existing concentrations back to, but not beyond S.

The dashed line, L, intersecting the axis of the second graph at T represents a reasonably accurate linear approximation to the total damage cost curve. The concentration level T is said to be the threshold, and incremental damages

Figure II.D.1

Approximations to the Cost of Air Pollution



Social Cost and Optimal Standard

Health Effects Threshold Model

Material and Vegetation Damage Proportionality Model are assumed to be proportional to concentration increments in excess of the threshold. Because of the absence of more accurate S-shaped curve data, linear approximations of this sort are used in the following analysis of health effects. Published literature includes threshold values for various health effects and associated dose-response multipliers (which can be interpreted as the slope of the line L (labelled z in the diagram).

The model employed for calculating material and vegetation damages is more simple than the threshold - dose response model used for health effects. These costs are calculated by assuming direct proportionality as indicated in the third diagram by the dotted line labelled D, passing through point P, with slope h. The Environmental Protection Agency has published estimates on a national basis of emissions and induced damages to materials and vegetation for 1968. By assuming that concentration increases are proportional to emission increments, the EPA data implies a point P on the TC_D curve. The relatively crude direct proportionality approach used herein estimates incremental damages by moving appropriately along the line D. Because this approximation is clearly inferior to the linear threshold model, its accuracy is even more sensitive to the assumption of small emission or concentration increments. Note ΔC for the third figure is less than ΔC for the second.

Simplistic as these models are, they nevertheless permit estimation of the actual damage costs of lease sale #48 pollutant emissions - information which we believe to be of considerably greater value to decision-makers than long tables of relatively opaque concentration predictions.

In the air quality analysis which follows, only damage costs are estimated. The rationale behind this choice is that damage costs are social costs at concentration levels less than S, and that beyond S (if such is the case), damage costs are an upper bound to social costs. Also, the calculation of elimination costs for the purpose of estimating social costs assumes implicitly that elimination activities will occur, when economic. This implies a decision on a joint enterprise of producing oil and gas and cleaning up emissions - which is not the nature of the lease sale decision as currently proposed.

However, state and local authorities may reasonably propose to link the two activities during negotiations regarding lease stipulations and the granting of air quality permits. In the event that the two activities are linked, damage cost estimates like those developed herein serve as a guide and upper bound to the amount appropriate for transfer from the producers to the private or public entities charged with cleaning up pollution.

ii. Overview of the Analysis

The fundamental goal of the analysis which follows is that of going from the production schedules of Table II.C.2. to dollar estimates of the health, material, and vegetation damages induced by lease sale #48 pollutant emissions. The road is a long one.

The bulk of the analysis is directed toward determining and evaluating health effects. The basic model applied to oil production is diagrammed in Figure II.D.2 and presented in equation form below:

$$h_{ji} = q \cdot q_{ei} \cdot \lambda_i \cdot t_{ji} \cdot d_{ji} \cdot b_j \cdot p,$$

h_{ji} = health effects of type j induced by incremental pollutant emissions of type i

q = oil production rate

q_{ei} = emissions factor for pollutant i

λ_i = concentration/conversion multiplier

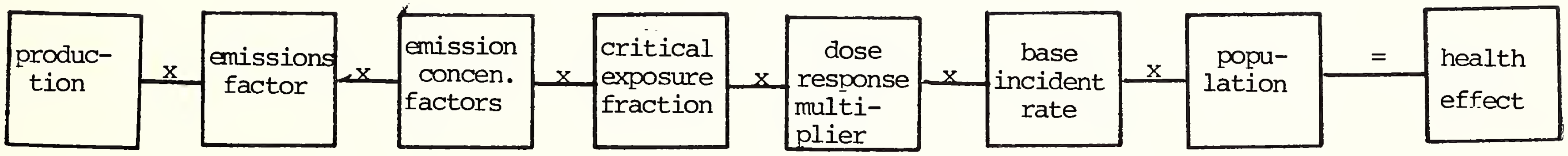
t_{ji} = critical exposure fraction

d_{ji} = dose response multiplier

Figure II.D.2.

Health Effects: Basic Deterministic Model

To determine a year's increase in short-term health effects of type j due to increased emissions of type i from oil and gas production in that year.



Symbol

q,g	ei	λi,γi	tji	dji	bj	p	hji

Units and Table Reference:

A. Production to Emissions.

$$\left[\underset{\text{Mbbl/day}}{(q)} \quad \overset{(qEi)}{\times} \quad \underset{\frac{\text{kg/hr}}{\text{Mbbl/day}}}{(qei)} \right] + \left[\underset{\text{MMcf/day}}{(g)} \quad \times \quad \underset{\frac{\text{kg/hr}}{\text{MMcf/day}}}{(gei)} \right] = \underset{\text{kg/hr.}}{(Ei)}$$

- Table II.C.2. Table II.D.4. Table II.C.2. Table II.D.4. Table II.D.5.

B. Emissions to Increased Concentrations [1].

SO_2-SO_4:	(E_{SO_2})	x	$\frac{1}{1000}$	x	$\frac{24}{1}$	x	(λ_{SO_2})			=	(ΔC_{SO_4})
	kg/hr		MT/kg		hr/day		$\frac{\Delta ug/m^3 SO_4}{MT/day\ SO_2}$				
CO:	(E_{CO})	x	$\frac{1}{1000}$	x	(λCO)			x	1145	=	(ΔC_{CO})
	kg/hr		MT/kg		$\frac{\Delta ppm\ CO}{MT/hr\ CO}$				$\frac{ug/m^3 CO}{ppm\ CO}$		$\Delta ug/m^3$
RHC-O_3:	(E_{RHC})	x	$\frac{1}{1000}$	x	(λRHC)	x	(γ)	x	1960	=	(ΔC_{O_3})
	kg/hr		MT/kg		$\frac{\Delta ppmC\ RHC}{MT/hr\ RHC}$		$\frac{\Delta ppmO_3}{\Delta ppmC\ RHC}$		$\frac{ug/M^3 O_3}{ppm\ O_3}$		$\Delta ug/m^3$
●	Table II.D.5		[2]	[2]	Table II.D.6		Table II.D.6		[3]		Table II.D.7.

C. Increased Concentrations to Health Effects.

	(ΔCi)	x	(tji)	x	(dji)	x	(bj)	x	(p)	=	(hji)
	$\Delta ug/m^3$		1 [4]		$\frac{1}{\Delta ug/m^3}$ [5]		$\frac{cases}{person\text{-}year}$		persons		$\frac{case\ ji}{yr.}$
●	Table II.D.7		Table II.D.12		Table II.D.13		Table II.D.14		Table II.D.15		Table II.D.17.

Notes:

[1]. We do not include NO_x and TSP emissions here because they are not expected to be a significant source of short term health effects. Other types of damage due to these pollutants are treated later in this air quality section.

[2]. Common unit conversion factors.

[3]. "ppm" means parts of pollutant per million parts of air, by volume.
"ug/m^3" means micrograms of pollutant per cubic meter of air.
The standard conversion factors employed here convert volume units to weight units at 25°C and 760 mm, and are taken from:
Three Year Summary of California Air Quality Data, State of California Air Resources Board, Technical Services Division, Air Analysis Branch and EDP Management Section. January 1977. p.341.

[4] tji is a fraction between 0 and 1, whose units cancel out. The units are critical periods per year divided by total periods per year.

[5] dji is a multiplier on bj, which expresses the increase in the base incident rate due to an increase in ΔCi. Hence the numerator has no unit.
Not shown in the Figure, but discussed in subsection D.2.d.vii. are the values used to compute point estimates and expected health costs.

bj = base incident rate
p = affected population

The technically oriented reader will notice that this simple model is homogeneous of first degree - that is, when one of the constituent variables is increased by X%, then the amount of adverse health effects increases by X% also. While it is probably true that the actual cause and effect relations do not exhibit this property, we know of no more accurate model that is also closed, in the sense of predicting health effects from production levels. The use of this model demonstrates the need to use the best available information (subject to analytic resource constraints) capable of being implemented in a decision-oriented analysis. We suggest that experts in the fields of air pollution and induced effects, in their more basic research, continue developing improved models which retain the closure feature of this simple model.

The material and vegetation damage model is very simple. EPA data was used to obtain damage costs per unit of emissions (denoted h_{mi} and h_{vi} below). Then the emissions calculated as an intermediate step in the health effects model were used with the EPA data to obtain the desired estimates. The equations for material and vegetation damages due to oil operations are given by:

$$Mi = q \cdot q_{ei} \cdot h_{mi}$$
$$Vi = q \cdot q_{ei} \cdot h_{vi}$$

Health effects due to suspended particulates are also calculated in this simple fashion. This practice was chosen because of an apparent lack of TSP data (e.g., thresholds and dose-response multipliers) compatible with the health effects model. Rather than ignore these effects entirely, this "back-of-the-envelope" alternative was implemented with the available EPA data.

b. Emissions

The purpose of this subsection is to present the data and techniques utilized to calculate emissions from lease sale #48 oil and gas operations. First, a simple network [6] showing alternative flows of oil and gas from the wellhead to refineries and gas utilities is presented. The network can be interpreted as a generalized scenario, in the sense that if specific values are given for its flow variables, then a particular scenario is implied. The network is used to determine the possible extremes of pollutant emissions, despite uncertainty regarding precisely how development and production will proceed.

As oil and gas flow through the network, emissions of various kinds and quantities are inevitable. These emissions are determined by applying activity emission factors derived from published sources to the appropriate flow of oil and gas through the activity (e.g., offshore loading and storage). The emission factors referred to in Figure II.D.2 are the sum of the emissions factors from constituent activities. Because of uncertainty in both the activity emission factors and the actual production scenario, large ranges are presented for the final production emission factors.

This subsection concludes with a comparison of emissions during the peak production year of 1986 with expected baseline emissions in the South Coast Air Basin (SCAB).

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[6] Networks of this sort for other energy resources are presented in Volume 4 of this study.

i. Oil and Gas Production Network

Figure II.D.3 shows the oil and gas production network used in this demonstration. The diagram consists of decision nodes (depicted by squares), activity nodes (depicted by circles), and flow variables, associated with decision nodes.

The flow variables indicate the fraction of oil or gas leaving a node with respect to the amount entering. Hence, the value of each is constrained between zero and one, inclusive. The definition of each flow variable follows:

x - fraction of q processed offshore

p - fraction of onshore processed crude, (1-x), transported to processing by pipeline.

t - fraction of onshore processed crude not transported to processing by pipeline, $(1-x)\cdot(1-p)$, that is transported onshore by tanker.

y - fraction of onshore processed crude, (1-x) transported by barge or tanker to the refinery.

b - fraction of processed crude transported by barge to the refinery.

z - fraction of g processed offshore.

The authority to set the flow variables lies with producers and with regulators to the extent that relevant conditions can be attached to needed permits. Since the producers are presumably concerned primarily with short- and long-run profits and the regulators are presumably concerned primarily with non-market effects, and their distribution, the desires of all parties will rarely coincide. The actual values of the flow variables will be set as a result of strategic interaction [7].

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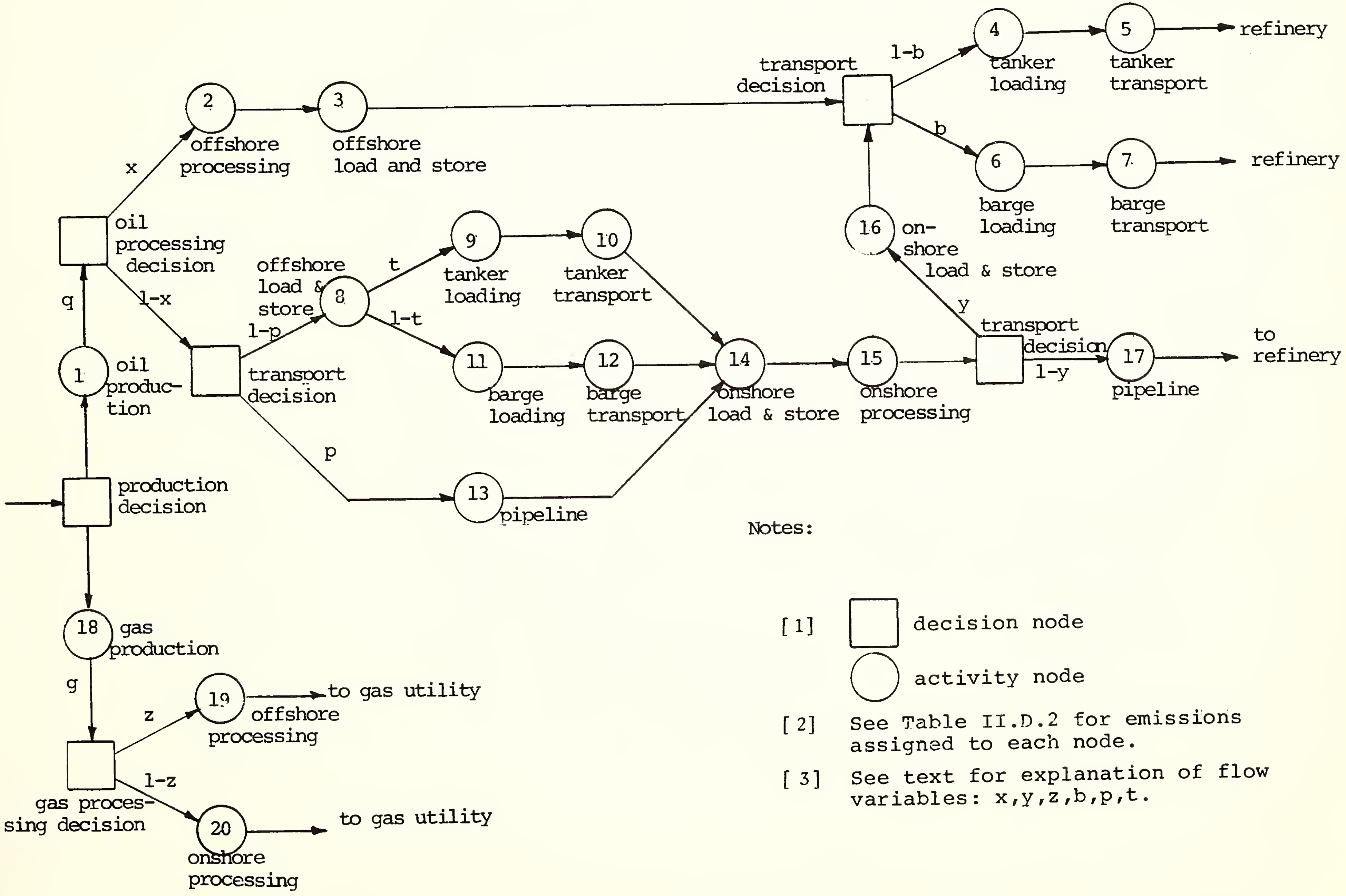
[7] For a discussion of the strategic aspects of energy facility siting, see the "Policy Analysis" of Volume 1 and the "Strategic Energy System" of Appendices B and C of Volume 3.

Figure II.D.3

Oil and Gas Production Network [1]

Activity Emissions [2] and Flow Variables [3]



Notes:

[1] ☐ decision node

○ activity node

[2] See Table II.D.2 for emissions assigned to each node.

[3] See text for explanation of flow variables: x,y,z,b,p,t.

ii. Activity Emission Factors

Pollutant emissions are associated with each activity node of Figure II.D.3. These activities may be classified generally as follows:

1. production - nodes 1 and 18
2. processing - nodes 2, 15, 19 and 20
3. loading - nodes 3, 4, 6, 8, 9, 11, 14, and 16
4. storage - nodes 3, 8, 14, and 16
5. transport - nodes 5, 7, 10, 12, 13, and 17.

By adding the emissions associated with each of these activities, weighted appropriately by the flow variables, the cumulative emission factors (ei) of Figure II.D.2 are obtained.

Table II.D.2. shows the activity emissions factors used in this demonstration. The values shown were derived,as shown in the notes to the Table, from data published in two studies funded by the State of California and the Bureau of Land Management [8]. Emission factors for the five pollutants of concern (SO_2, CO, RHC, NO_x, TSP) are given in terms of probable ranges and point estimates.

Emissions due to loading and storage are hydrocarbons only. Emissions of the other three activity classes are more diverse because of fuel burning.

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[8] Offshore Oil and Gas Development: Southern California, California Office of Planning and Research, October 1977. Air Quality Analysis of the Southern California Bight in Relation to Potential Impacts of Offshore Oil and Gas Development, Aero Vironment, Inc.

Table II.D.2

Activity Emission Factors [1]

Oil Production [2]: units - (kg/hr)/ (Mbbl/day)

Pollutant	Production [3] fp	Processing [4] fpr	Offshore Storage [5] fsx	Onshore [6] fso
SO_z	0.08 - 0.30 (0.15)	- -	- -	- -
CO	0.16 - 0.64 (0.32)	- -	- -	- -
RHC	0.22 - 0.88 (0.44)	0.25 - 0.98 (0.49)	0.02 - 0.08 (0.04)	* - 0.02 (0.01)
NO_x	0.21 - 0.82 (0.41)	0.41 - 1.64 (0.82)	- -	- -
TSP	0.08 - 0.30 (0.15)	- -	- -	- -
Node	1	2,15	3,8	14,16

Pollutant	Offshore [7] Loading flsx	Onshore [8] flso	Tanker [9] Loading flt	Barge [10] flb
SO_2	-	-	-	-
CO	-	-	-	-
RHC	0.40 - 1.60 (0.80)	* - * *	0.35 - 1.40 (0.70)	1.05 - 4.20 (2.10)
NO_x	-	-	-	-
TSP	-	-	-	-
Node	3,8	14,16	4,9	6,11

Transportation [11]

Pollutant	Tanker [12]		Barge [13]		Pipeline [14]
	$f_t\ t_x$	$f_t\ t_o$	$f_t\ b_x$	$f_t\ b_o$	$f_t\ p$
SO_2	0.11 - 0.42 (0.21)	0.06 - 0.22 (0.11)	0.02 - 0.08 (0.04)	0.01 - 0.04 (0.02)	 -
CO	* *	* *	* - 0.01 *	* - 0.01 *	- -
RHC	* *	* *	* - 0.01 *	* *	- -
NO_x	0.03 - 0.12 (0.06)	0.02 - 0.06 (0.03)	0.03 - 0.12 (0.06)	0.02 - 0.06 (0.03)	- -
TSP	0.02 - 0.06 (0.03)	0.01 - 0.04 (0.02)	0.01 - 0.04 (0.02)	* - 0.02 (0.01)	- -
Node	5	10	7	12	13,17

Gas Production [2]: units - (kg/hr) / (MMcf/day)

Pollutant	Production [15]	Processing [16]
	fpg	fprg
SO_2	-	0.10 - 0.40 (0.20)
CO	-	-
RHC	- -	0.64 - 2.54 (1.27)
NO_x	(0.48 - 1.90) (0.95)	1.38 - 5.55 (2.77)
TSP	- -	- -
Node	18	19,20

Sources:

1. Offshore Oil and Gas Development: Southern California, California Office of Planning and Research, October 1977.
2. Air Quality Analysis of the Southern California Bight in Relation to Potential Impacts of Offshore Oil and Gas Development, Aero Vironment, Inc.

Notes:

[1] In all cases, the range is simply half and double the point estimate. If only one or several identical values were found in the sources, then that value was used as the point estimate in parentheses. When several distinct values were found in the sources, the range and implied point estimate were obtained by placing the range symmetrically with respect to the extreme values cited in the sources. Thus, if a and b are the published extremes, the point estimate $x = 0.4(a+b)$. Also, a - indicates the absence of data or emissions, while a * that the emission rate factor is less than 0.01 (kg/hr)/(Mbbl/day or MMcf/day.)

[2] Emissions from drilling are excluded as insignificant. Nevertheless, AeroVironment, *op.cit*, p. 27 cites the following activity emission factors for well drilling (derived from EPA, AP-42) in kg/hr-well drilled:

SO_2	1.0	RHC	1.4	TSP	1.2
CO	3.7	NO_x	1.7		

[3] Both sources agree on all factors except RHC. AeroVironment, *op. cit.* p. V-3 cites a value of 0.38 and OPR, *op. cit.*, p. 230 cites a value of 0.73.

[4] Both sources agree on all factors except RHC. AeroVironment, *op. cit.*, p. V-3 cites a value of 0.38 and OPR, *op. cit.* p. 230 cites a value of 0.85. fpr is used for both onshore and offshore processing (nodes 2 and 15 of Figure II.D.3).

[5] Offshore storage is assumed to be fixed roof. AeroVironment, Inc. *op. cit.* estimates HC emission rate factors for fixed roof containers at 0.120 lb/hr - Mbbl capacity for tanks under 70 Mbbl capacity and 0.086 for tanks over 70 Mbbl capacity (p.V-12). They also estimate (on p. V-21) an increase in capacity due to production of lease sale #48 crude in 1986 of 150 -170 Mbbl in large tanks and 22 - 82 Mbbl in small tanks, where the lower figure assumes "normal tankering" and the higher figure assumes "100% tankering". After converting lbs to kg and dividing by the 220 Mbbl production rate, their data implies offshore storage HC emissions of .041 - .057 (kg/hr)/(Mbbl/day).

[6] Onshore storage is assumed to be floating roof. AeroVironment, Inc. *op. cit.* p.V-12 estimates that HC emission rate factors for floating roof storage are ¼ that for fixed roof storage.

Notes (continued)

[7] Hydrocarbon emissions during loading are caused by the need to vent hydrocarbon laden air while filling the tank. AeroVironment, Inc., *op. cit.*, p. V-12 estimates these emissions to be 0.56 - 1.43 (kg/hr)/(Mbbl/day), where the range derives from calculations based on Dos Cuadras and Wilmington crude, respectively.

[8] AeroVironment, Inc., *op. cit.*, p. V-12 reports that loading emissions from floating roof tanks *are negligible*.

[9] AeroVironment, Inc. *op. cit.*, p. V-10 reports factors of 1.6 - 0.6 lbs HC/thousand gal. loaded *for* Das Cuardras and Wilmington crude, respectively, which imply factors of 0.48 - 1.27 (kg/hr)/(Mbbl/day).

[10] AeroVironment, Inc., *op. cit.*, p. V-10 reports factors which imply rates of 1.43 - 3.82 (kg/hr)/(Mbbl/day), *for* Das Cuadras and Wilmington crude, respectively.

[11] All transportation factors include pumping emissions for loading, but not for unloading. This is because if lease sale #48 crude displaces other crudes which were tankered or barged, the difference in emissions due to unloading would be insignificant, or if the crude is pipelined to the interior, emissions would be counted against the marine terminal.

[12] The formula for determining tanker emissions is:

$$\frac{\text{kgi}}{\text{bbl fuel}} \cdot \frac{\text{bbl fuel}}{\text{rd. trip}} \cdot \frac{\text{rd trips}}{\text{Mbbl}} \cdot \frac{\text{day}}{\text{hr}} = \frac{\text{kg/hr}}{\text{Mbbl/day}}$$

AeroVironment, Inc., *op. cit.*, p. V-7 reports data for the combusion of No.6 fuel oil (0.5%S) *which when* converted to kg/bbl yield SO_2 - 3.02, CO - 0.04, HC - 0.06, NO_x - 0.91, TSP - 0.44, and which constitute the first factor in the above equation. On p. V-22, fuel consumption rates of 27.5 bblf/hr while underway and 10.0 bblf/hr while loading are reported, for a 400 Mbbl tanker. The two factors, ft tx and ft to, refer to tanker scenarios with offshore and onshore processing, respectively. In the first case, a 17 hr round trip is assumed corresponding to delivery at L.A. - L.B. or transportation via the Panama Canal. In the second case, a 5 hr round trip is assumed corresponding to delivery for onshore processing in the Santa Barbara - Ventura County area. These assumptions along with the 10 hr loading time cited on p. V-23 imply the second factor for both cases. The third and fourth factors are 1/400 and 1/24.

Notes (continued)

[13] The formula for calculating barge emissions is similar, but more complicated than that for tanker emissions, because different engines are used for pumping and locomotion, and because significant differences exist in fuel consumption for small and large tugboats (and barges). AeroVironment, Inc., *op. cit.*, p. V-7, cites emissions data for tugboat engines, which when converted to kg/bblf are SO_2 - 0.53, CO - 0.08, HC - 0.06, NO_x - 0.85, TSP - 0.29 and for barge pumps, which when converted are SO_2 - 0.53, CO - 1.94, HC - 0.71, NO_x - 8.91, and TSP - 0.64. On page V-22, fuel consumption rates for a 10 Mbbl barge and 800 hp tugboat are given, which when converted are 0.83 bblf/hr underway and 0.12 bblf/hr while loading, and for a 100-150 Mbbl barge and 2000 hp tugboat, which when converted are 1.79 bblf/hr underway and 0.24 bblf/hr while pumping on. The two factors, ft bx and ft bo, refer to barge scenarios with offshore and onshore processing respectively as described in the previous note. Round trip durations of 40 and 15 hrs are assumed for the two cases. These assumptions, along with the 2 and 10 hr loading times cited on p.V-23 for the small and large barges imply fuel consumption (round trip). While the fourth factor is again 1/24, the third factor is 1/10 or 1/125 as appropriate. The ranges for these factors cover the extremes of the small and large barge cases.

[14] No data was found for pipeline pumping emissions. In calculating cumulative emissions, the best case was determined using zero emissions from pipelines. Thus the best case understates emissions, just as the worst base overstates emissions.

[15] OPR, *op. cit.*, p.230.

[16] *Ibid.* fprg is used for both onshore and offshore processing (nodes 18 and 19 of Figure II.D.3).

Note also that refinery emissions are not included. This is because refineries are best associated with consumption rather than with the production of crude for the world market. Emissions are calculated for all activities from production at the wellhead to pumping processed crude into tankers, barges, or storage tanks for delivery to southern California refineries or for transport beyond its boundaries. (Transport emissions within the southern California air basin due to transshipment are included.)

A careful inspection of Table II.D.2. shows that the ranges given are most conservative, easily containing previously published low and high estimates. The point estimates in parantheses below the ranges are used for the point estimates of subsequent calculations.

iii. Network Equations and Emission Factor Derivation

In the preceding two parts of this subsection, the production network was presented and the activity emission factors were derived. With this information, it is possible to derive the production emission factors of Figure II.D.2.

The first step is to write down an equation for each activity node in the network, as shown in Table II.D.3. Note that the right hand side of each equation consists of two parts. The first part is a product of flow variables and the second part is the activity emission factor associated with the node.

Consider for example, the second equation which describes the second node:

$$e_2 = x \cdot fpr$$

This equation states that emissions resulting from offshore processing are equal to the fraction of daily production which is processed offshore (x) multiplied by the hourly emissions from offshore processing per thousand barrels of daily crude production (fpr). Note that uncertainty regarding the percentage of production processed offshore can be included in x and that uncertainty regarding the offshore processing emissions rate can be included in fpr. At this stage of the analysis, uncertainty in fpr is given roughly by the range in Table II.D.2., and that for the flow variable x is given by allowing x to range between zero and one.

In order that the network equations not appear overly mysterious, consider for a second example, the thirteenth equation corresponding to node seven:

$$e_7 = [x + y \cdot (1-x)] \cdot b \cdot f_{tbx}.$$

Once again, the second part is an activity emission factor. As pointed out in Note [13] of the preceding Table f_{tbx} represents the hourly emissions per thousand barrels of daily oil production in (kg/hr)/(Mbbl/day) resulting from pumping and transporting via barge over a forty-hour round trip. The bracketed quantity is the fraction of daily oil production which could enter node seven, namely the fraction processed offshore (x) plus the fraction (y) of onshore processed crude (1-x) destined for transport to the refinery by barge or tanker. The fraction which actually enters node seven is the bracketed quantity multiplied by the fraction which is barged (b) rather than tankered.

The next step in deriving the production emission factors is simply that of adding up the seventeen equations for oil and the three for gas. (They must be kept separate because of different daily production measures.) While the required summation is simple in concept, it does, of course, produce a lengthy expression, involving the flow variables and the activity emission factors.

In order to develop a probable range for the production emission factors, it is necessary to extremize the network (i.e., the sum of the network equations,) with respect to each of the pollutants of concern by varying the flow variables from zero to one. This can be done analytically and is easily adapted for computerized solution [9]. Were our network more complex formal solution techniques would be warranted.

Fortunately however, the maximum and minimum production emission factors can be found by inspection of the network and the activity emission factors. First, it can be seen that emissions of CO, NO_x, and TSP are insensitive to (i.e., all but constant with respect to changes in) the flow variables. Second, it can be seen that the principal tradeoff is between SO_2 and RHC, as a function of transportation modes. That is,

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[9] The extremals of this network correspond to various solutions of an associated linear program.

Table II.D.3

Production Network Emissions Equations [1]

Oil Operations (17 nodes)

Production:

(1) $e_1 = fp$

Processing:

(2) $e_2 = x \cdot fpr$

(3) $e_{15} = (1-x) \cdot fpr$

Load and Store:

(4) $e_3 = x \cdot (f_{lsx} + f_{sx})$

(5) $e_8 = (1-x) \cdot (1-p) \cdot (f_{lsx}+f_{sx})$

(6) $e_{14} = (1-x) \cdot (f_{lso}+f_{so})$

(7) $e_{16} = y \cdot (1-x) \cdot (f_{lso}+f_{so})$

Load for Transport:

(8) $e_4 = [x+y \cdot (1-x)] \cdot (1-b) \cdot f_{lt}$

(9) $e_6 = [x+y \cdot (1-x)] \cdot b \cdot f_{lb}$

(10) $e_9 = (1-x) \cdot (1-p) \cdot t \cdot f_{lt}$

(11) $e_{11} = (1-x) \cdot (1-p) \cdot (1-t) \cdot f_{lb}$

Transport and Pump:

(12) $e_5 = [x+y \cdot (1+x)] \cdot (1-b) \cdot f_{ttx}$

(13) $e_7 = [x+y \cdot (1-x)] \cdot b \cdot f_{tbx}$

(14) $e_{10} = (1-x) \cdot (1-p) \cdot t \cdot f_{tto}$

(15) $e_{12} = (1-x) \cdot (1-p) \cdot (1-t) \cdot f_{tbo}$

(16) $e_{13} = (1-x) \cdot p \cdot f_{tp}$

(17) $e_{17} = (1-x) \cdot (1-y) \cdot f_{tp}$

Gas Operations (3 nodes)

Production:

[18] $e_{18} = f_{pg}$

Processing:

[19] $e_{19} = z. fprg$

[20] $e_{20} = (1-z) \cdot f_{prg}$

Notes:

[1] The dimensions of the e's and f's are the same, (kg/hr)/(Mbbl/day) or (kg/hr)/(MMcf/day), since the flow variables, x,y,z,p,b, and t, are dimensionless fractions between zero and one. The subscripts on the e's refer to the node numbers of Figure II.D.2. See Table II.D.2 for a detailed explanation of activity emission factor calculations.

because of the fuel burned, tankers emit more SO_2 but less RHC, and barges more RHC but less SO_2, during the loading, storage, transport, and pumping activities. Hence, the maximum SO_2 emission factor is found by maximizing tanker transport and the maximum RHC factor is found by maximizing barge transport, although both cannot occur simultaneously.

These transportation modes are maximized by positing an unlikely scenario. It is necessary that all crude be processed onshore ($x=0$), transported to processing by other than the pipeline mode ($p=0$), but tankered or barged instead, and finally that the crude not be pipelined to the refinery ($y=1$) but rather be tankered or barged instead over a long route affecting the air basins of concern. Given this, the maximum SO_2 factor is found by having $t=1$ and $b=0$ corresponding to all tanker transport and the maximum RHC factor is found by having $t=0$ and $b=1$ corresponding to all barge transport.

Minimimum emissions are obtained by transporting all crude via pipeline for onshore processing and transporting the product to the refinery also by pipeline ($x=0$, $p=1$, $y=0$, t and b irrelevant). Since data regarding pipeline emission factors was not found, this statement is based on the assumption that pipelines are the least polluting of the three modes.

The results of these calculations are the ranges and point estimates for production emission factors as shown in Table II.D.4. Note that the order of the ranges would approach four if better information were available regarding actual production plans.

Table II.D.4

Oil and Gas Production Emission Factors

Pollutant	Oil Production Factor [1] (kg/hr)/(Mbbl/day) (ql_i)	Order [2]	Gas Production Factor (kg/hr)/(MMcf/day) (gl_i)	Order [2]
SO_2	0.08 - 0.94 (0.41)	12	0.10 - 0.40 (0.20)	4
CO	0.16 - 0.64 (0.32)	4	- -	-
RHC	0.47 -18.28 (7.50)	39	0.64 - 2.54 (1.27)	4
NO_x	0.62 - 2.64 (1.30)	4	1.86 - 7.45 (3.72)	4
TSP	0.08 - 0.40 (0.19)	5	- -	-

Notes:

[1] Maximum SO_2 and RHC cannot occur simultaneously. Minimum values neglect pipeline transportation emissions.

[2] Given a range $\mu_1 - \mu_2, \mu_1 \neq 0$, the order is $\mu_2 \div \mu_1$. Orders of four are due to the ranges assumed in Table II.D.2 and based on published activity emissions data. Orders in excess of four are due to uncertainty in actual production plans.

iv. Emissions in 1986

As indicated in Figure II.D.2, multiplying the production emission factors of the preceding Table by daily production rates yields emissions in kg/hr. Table II.D.5 presents the results of such calculations for 1986, the year of expected peak oil production, and compares the implied emissions with projected baseline figures for the South Coast Air Basin. Although this comparison is conservative, it nevertheless shows that the pollution increment from lease sale #48 is weighted toward the smog producing elements of RHC and NO_x. The increment in SO_2 will also prove significant in light of the sensitivity of humans to sulphate induced diseases. Actually, it is premature to draw health oriented conclusions at this stage of the analysis - important factors yet to be discussed include the critical exposure fractions and the dose response multipliers.

However, several comments on the analysis to date are warranted. First, we recommend that networks be used to capture uncertainty in production scenarios because of their flexibility and the ease with which they can be updated and manipulated by computers. While it is recognized that the network presented here for demonstration purposes is quite elementary, there is no doubt that analysts at oil companies or in industry associations could construct a more accurate version well before the publication of a draft environmental impact statement. These groups could also provide better information regarding production scenarios in the form of probability distributions on the flow variables. (In the absence of such, we have implicitly assumed a uniform distribution over the interval [0,1].) If a more accurate network were available, it would be possible to differentiate between the emissions of different types of equipment, rather than making do with point estimates and ranges for broad activities such as processing.

Table II.D.5

Pollutant Emissions [1], 1986 [2]

Projected SCAB Baseline Figures and Lease Sale #48 Increments

Pollutant	Oil-induced emissions (qEi)	Gas-induced emissions (gEi)	qEi + gEi (Ei)	Projected [3] SCAB base (B_i)	Ei/Bi [4] %
SO_2	18 - 207 (90)	26 - 104 (52)	44 - 311 (142)	20,000	0.17 - 1.20 (0.55)
CO	35 - 141 (70)	[5]	35 - 141 (70)	120,000	0.03 - 0.12 (0.06)
RHC	103 - 4022 (1650)	166 - 660 (330)	269 - 4682 (1980)	35,000	0.77 - 13.38 (5.66)
NO_x	136 - 581 (286)	484 - 1937 (967)	620 - 2518 (1253)	40,000	1.55 - 6.30 (3.13)
TSP	18 - 88 (42)	[5]	18 - 88 (42)	12,000	0.02 - 0.22 (0.11)

Notes:

[1] All emissions in kg/hr

[2] From Table II.C.2., 1986 is the year of peak oil production, and q = 220 Mbbl/day; g = 260 MMcf/day

[3] AeroVironment, Inc., *op. cit.*

[4] These percentage figures are for illustrative purposes only, since not all of the lease sale #48 derived emissions will accrue to SCAB. Hence, these percentage figures overstate the lease sale #48 increment.

[5] See Table II.D.2.

Despite our interest in a more accurate and flexible emissions network model, we emphasize that such improvements should be seen in the context of general research and not made mandatory for decision documents. Put simply, there is no need to complicate and perfect a model for decision purposes unless the information gained has the potential of changing the decision. Attempts to require ever more detailed and complete decision oriented analyses on general principle are often seen as transparent tactics of delay.

c. Concentration Increases

Health effects occur as the result of increases in the concentration of critical pollutants. The concentration of any particular pollutant generally varies over space and time. The sources of variation include the location of emission sources, topography, winds, sunlight intensity, temperature, and the presence of other chemically reactive substances in the atmosphere.

There are basically two approaches in current use for calculating concentration increases due to emission increments. The first and simplest approach is used for the purposes of this demonstration, and is called roll back or proportional modeling [10]. The fundamental assumption is represented by the following equation for some pollutant i:

$c_i = b_i + \lambda_i E_i$, where

c_i = actual concentration,
b_i = background concentration,
E_i = rate of emission, and
λ_i = concentration/conversion multiplier.

This equation says that concentration is a linear function of emissions, namely a fixed value (b_i) plus a proportion based on emissions ($\lambda_i E_i$). Since b_i and λ_i are assumed constant, this equation implies:

$$\Delta c_i = \lambda_i \Delta E_i$$

Given emission increments (ΔE_i) like those presented in Table II.D.5 and values for λ_i, Δc_i follows directly.

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[10] Noel de Nevers and J. Roger Morris, "Rollback Modeling: Basic and Modified", Journal of the Air Pollution Control Association. (Vol. 25, No. 9, pp 943-8, Sept. 75).

In general, this approach becomes more accurate as the ratio of emission increments to total emissions approaches zero ($\Delta E_i/E_i \rightarrow 0$) so that the effects of non-linearities are minimized, and as the spatial and temporal distribution of emission increments approaches that for total emissions. In the case of lease sale #48, Table II.D.5 shows that the first condition is approximated. Inaccuracy seems more likely to result because of differences in the distributional patterns of incremental and total emissions.

The second approach for calculating concentration increases due to emission increments requires extensive and extremely complex computer simulation. Spatially and temporally varying data regarding the previously mentioned factors (and many more) are input to a system of chemical reaction and fluid dynamic atmospheric equations, with the resultant output being the desired concentration maps. While this technique is attractive from a scientific perspective because of its more sophisticated inputs, model, and output, it is not necessarily desirable for a decision-oriented analysis. Data gathering, model construction, computer solution, and output synthesis and interpretation are generally complex, costly, and time consuming. The relevant question for the decision-maker is whether the results of improved accuracy would justify the additional expense in terms of the likelihood of changing a decision.

Note finally that, if concentrations are obtained as explicit functions of space and time, then for a balanced decision-oriented analysis, data on emissions, critical exposure fractions, and population should be likewise defined over space and time in order to obtain a general and complete distribution of health effects. This point corresponds to that made in Chapter I, that the links of a model chain should adhere to the equal marginal improvement rule.

i. Concentration/Conversion Multipliers

Because of the absence of data on health effects due to TSP and NO_x [11], concentration increases are not calculated in the following for these two pollutants. Material damage due to these two pollutants is estimated from emissions data later in section D.2.e.

The remaining three types of pollutant emissions have direct or indirect health effects. Carbon monoxide concentrations in excess of critical medically derived thresholds for periods of eight hours or more can cause excess cardiac deaths. This relationship is direct in the sense that no chemical reaction need occur.

Emission of sulphur dioxide (SO_2) undergo a chemical reaction in the atmosphere which transforms them into sulphates (SO_4). Humans are quite sensitive to daily average concentrations in excess of critical thresholds.

Health effects due to reactive hydrocarbons (RHC) derive from a complex process in which RHC and NO_x combine to form oxidants (notably ozone, O_3). Hourly average concentrations of oxidants in excess of thresholds induce health effects. In the case of RHC, a concentration/conversion multiplier (λRHC) is presented which converts hourly emissions of RHC to the early morning RHC concentration expressed in terms of its methane equivalent. Next, a second concentration/conversion factor (γ) is presented for transforming the early morning methane equivalent RHC concentration to hourly concentrations of oxidants. The uncertainty in both these factors adds even more to the already large order of uncertainty for RHC effects.

The concentration/conversion multipliers used in this demonstration are shown in Table II.D.6. An explanation of the γ factor used for the RHC - 0_3 process follows:

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[11] NO_x and RHC interact to form oxidants, which do have health effects. This interaction is discussed later in this subsection. TSP health effects are estimated in subsection D.2.1.

Although no harmful health effects have been directly attributed to ambient concentrations of hydrocarbons, some hydrocarbon molecules are chemically reactive. In the presence of nitric oxide (NO) and sunlight, these contribute to the formation of photochemical oxidants known to be harmful to human health. The relationship between concentrations of NO_x, RHC, and oxidants is extremely complex, varying with weather, location, and other emission sources.

The relationship is established for the purposes of this demonstration by using a modified version of the Empirical Kinetic Modeling Approach (EKMA) developed by the Environmental Protection Agency [12]. The EKMA predicts afternoon concentrations of ozone (O_3) from morning concentration of RHC, and the RHC/NO_x ambient concentration ratio.

Figure II.D.4 depicts this relationship for three values of the RHC/NO_x ratio. The three ratios represent the fifth percentile (6.0: 1), the median (9.5: 1), and the ninety-fifth percentile(16.0: 1) of observed values in the Los Angeles metropolitan area. The slope of each curve indicates the change in ozone concentration which results from a small change in the morning RHC concentration. The range on the factor γRHC of Table II.D.6 was derived by bounding the three curves with the straight lines shown in Figure II.D.4., while the point estimate was obtained by selecting the mid-point in the slope range of the median curve.

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[12] Uses, Limitations, and Technical Basis of Procedures for Quantifying Relationships Between Photochemical Oxidants and Precursors. (EPA 450/2-77-021A. November, 1977).

Table II.D.6

Concentration/Conversion Multipliers

Multiplier	Unit	Probable Range	Order
λ_{SO_x} [1]	$\frac{\Delta\ ug/m^3\ SO_4}{\Delta\ MT/day\ SO_2}$	0.005 - 0.100 (0.045)	20
λ_{CO} [2]	$\frac{\Delta\ ppm\ CO}{\Delta MT/hr\ CO}$	0.001 - 0.100 (0.040)	100
λ_{RHC} [2]	$\frac{\Delta\ ppmC\ RHC}{\Delta\ MT/hr\ RHC}$	0.001 - 0.100 (0.040)	100
γ_{RHC} [3]	$\frac{\Delta\ ppm\ O_3}{\Delta\ ppmC\ RHC}$	0.170 - 0.550 (0.350)	3

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[1] El Paso Gas Co., Docket No. RP72-6, "Testimony Before the Federal Power Commission - Answering Environmental Testimony submitted by California State Air Resources Board."

- o estimated λ_{SO_2} for S.C.A.B. at λ = .03
- o F.P.C. staff estimates for El Paso Project estimated λ = .06 for S.C.A.B.

[2] Estimate based on emissions and concentration data given in AeroVironment, Inc., op. cit.

[3] For derivation, see discussion accompanying Figure II.D.4.

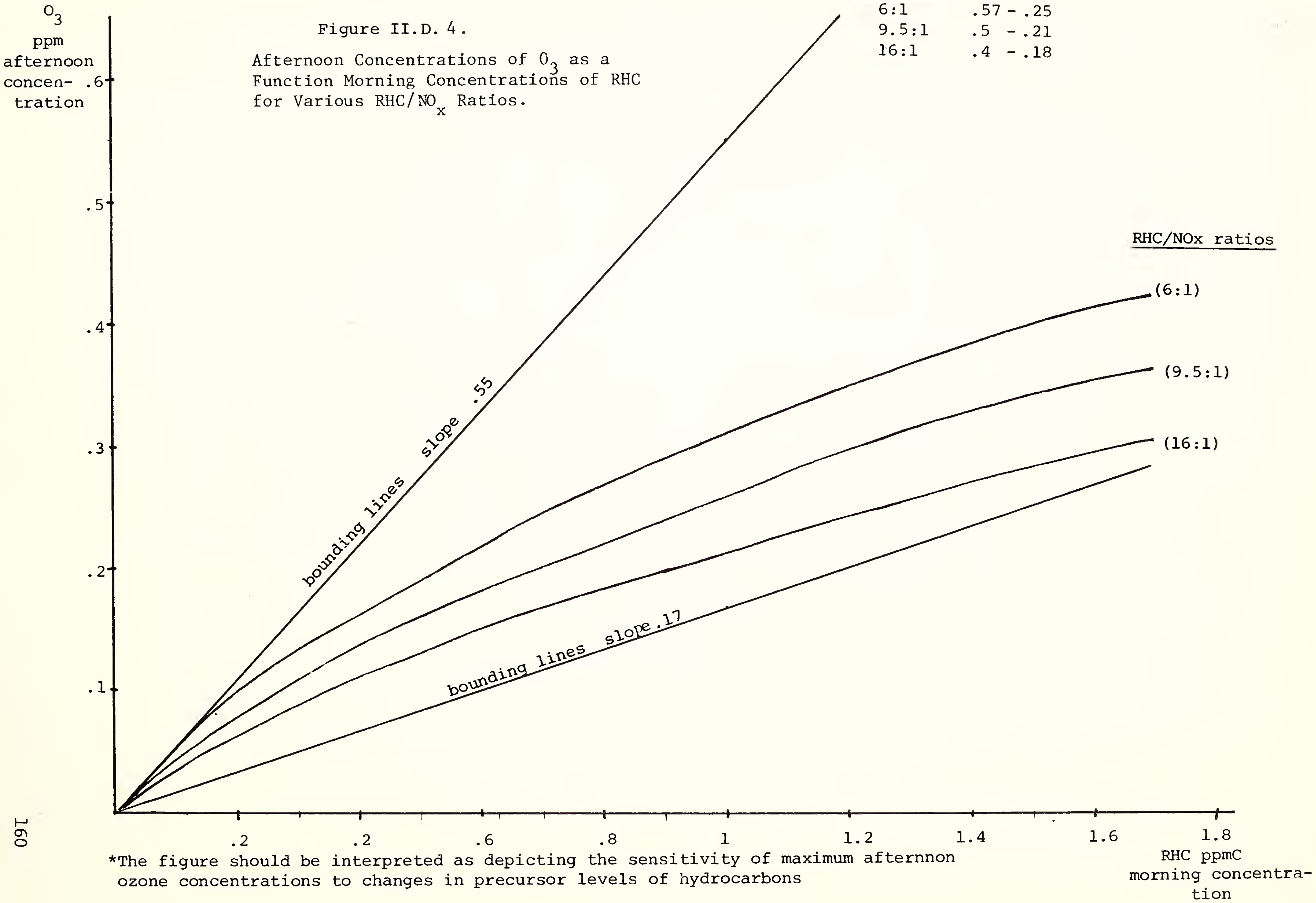

Figure II.D. 4.

Afternoon Concentrations of O_3 as a Function Morning Concentrations of RHC for Various RHC/NO_x Ratios.

RHC/NO_x ratio	Range of slope
6:1	.57 - .25
9.5:1	.5 - .21
16:1	.4 - .18

*The figure should be interpreted as depicting the sensitivity of maximum afternnon ozone concentrations to changes in precursor levels of hydrocarbons

ii. Concentration Increases in 1986

As indicated in Figure II.D.2, the emissions estimates of Table II.D.5 and the concentration/conversion multipliers of Table II.D.6, can (with care for units) be used to determine increases in concentrations due to lease sale #48 production activities. For illustrative purposes, the results of these calculations for 1986 are presented in Table II.D.7. The dramatic increase in the order of the range of uncertainty introduced by the data of this subsection should be noted.

Table II.D.7

Pollutant Emissions and Concentration Increases, 1986 [1]

Pollutant [2]	Emission Rate (kg/hr) [3]	Order of Range [4]	Concentration Increase Δl_i (Δug/m^3)	Order of Range [4]
Oil Operations: q = 220 Mbbl/day				
SO_2 - SO_4	18 - 207 (90)	12	0.002 - 0.497 (0.097)	230
CO	35 - 141 (70)	4	0.040 - 16.145 (3.206)	403
RHC - O_3	103 - 4022 (1650)	39	0.034 - 433.572 (45.276)	12,633
Gas Operations: g = 260 MMcf/day				
SO_2 - SO_4	26 - 104 (52)	4	0.003 - 0.250 (0.056)	80
CO	- -	- -	- -	- -
RHC - O_3	166 - 660 (330)	4	0.055 - 71.148 (9.055)	1286
Combined:				
SO_2 - SO_4	44 - 311 (142)	7	0.005 - 0.746 (10.153)	141
CO	35 - 141 (70)	4	0.040 - 16.145 (3.206)	403
RHC - O_3	269 - 4682 (1980)	17	0.090 - 504.720 (54.331)	5631

Notes:

[1] 1986 is the year of anticipated peak oil production.

[2] The emission rates refer to SO_2 and RHC, which after complex atmospheric chemical reactions induce concentration increases in SO_4 and O_3, respectively. The dose response multipliers are with respect to the latter pollutants.

[3] See Tables II.D.5 and II.C.2.

[4] The order of a range $\mu_1 - \mu_2$ (with $\mu_1 \neq$) is simply μ_2/μ_1. The order is a rough measure of uncertainty. The very large order for ΔC_{O_3} is due to significant uncertainty regarding oil storage and transportation, and the nature of the $RHC\text{-}O_3$ reaction.

d. Health Effects

It is assumed that adverse health effects begin to appear when concentrations exceed critical medically derived thresholds which in general vary for each pollutant and each health effect under consideration. Once the threshold is reached, and maintained or exceeded for a minimal critical period, increases in adverse health effects are assumed proportional to increases in ambient concentrations. The actual increase in air pollution induced casualties from increased concentrations due to lease sale #48 OCS operations in thus dependent on:

1. pre-existing ambient concentrations (since in light of the marginal nature of lease sale #48 induced emissions, these concentrations are the primary determinant of the number and duration of periods in which critical thresholds are exceeded and OCS increments cause health effects),
2. the average sensitivity of the affected population to concentrations in excess of the thresholds,
3. the base incident rates for the health effects under consideration, and
4. the size of the affected population.

It is the purpose of this subsection to discuss these four topics and present the data utilized to estimate ranges for the model variables remaining. As will be seen, the assumptions used tend to overstate the severity of lease sale #48 induced short-term health effects.

i. Threshold Definitions

Table II.D.8 shows the critical concentration level and critical minimum exposure period for the four short-term, pollution induced health effects under consideration in this demonstration. Note that NO_x and TSP are not included in this Table - their adverse effects are treated later in subsection D.2.e.

Table II.D.8

Short Term Health Effect Threshold Definitions

j	Health Effect	Threshold Concentration and Critical Duration [1]		
		Sulfates (SO_4)	Oxidants (O_3)	Carbon Monoxide (CO)[2]
1.	Premature Death - SO_4	25 ug/m^3 1 day or more	-	-
2.	Aggravation of Heart and Lung Disease	9 ug/m3 - 1 day or more	400 ug/m^3 1 hour or more	-
3.	Aggravation of Asthma	6 ug/m^3 - 1 day or more	400 ug/m^3 1 hour or more	-
4.	Excess Cardiac Deaths - CO	-	-	10,300 ug/m^3 8 hour avg.

Source: W.C. Nelson, et al., Air Pollutant and Health Effects Estimation Model, Health Effects Research Laboratory, E.P.A., Research Triangle Park.

Notes:

[1] The critical duration shown beneath the critical concentration is the "critical period" referred to in note [4] of Fig.II.D.2.

[2] The threshold concentration for CO induced excess cardiac deaths is given as between 10.3 and 16.0 mg/m^3 (9-14 ppm). The lower value is used here for conservation and reflects the stricter of two national standards.

ii. Federal and State Air Quality Standards

It is important to recognize that the thresholds discussed in the preceding are not another name for federal and state air quality standards, which are presented for comparison purposes in Table II.D.9. Although the violation of legal standards results in costs (in the form of reduced funding of air quality programs and charges of malfeasance) to the responsible state and local agencies, we do not consider these to be true costs induced by air pollution.

Table II.D.9.

TABLE III-1. Ambient air quality standards.

Pollutant	Averaging Time	California Standards[1] Concentration	National Standards[2] Primary	National Standards[2] Secondary
Oxidant (Ozone)	1 Hour	0.10 ppm (200 μg/m^3)	160 μg/m^3 (0.08 ppm)	Same as Primary Std.
Carbon Monoxide	12 hour	10 ppm (11 mg/m^3)	--	
	8 hour	--	10 mg/m^3 (9 ppm)	Same as Primary Standards
	1 hour	40 ppm (46 mg/m^3)	40 mg/m^3 (35 ppm)	
Nitrogen Dioxide	Annual Average	--	100 μg/m^3 (0.05 ppm)	Same as Primary Standards
	1 hour	0.25 ppm (470 μg/m^3)	--	
Sulfur Dioxide[3]	Annual Average	--	80 μg/m^3 (0.03 ppm)	--
	24 hour	0.04 ppm (105 μg/m^3)	365 μg/m^3 (0.14 ppm)	--
	3 hour	--	--	1300 μg/m^3 (0.5 ppm)
	1 hour	0.5 ppm (1310 μg/m^3)	--	--
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility to less than 10 mi. when rel. humidity is less than 70%	--	--
Suspended Particulate Matter	Annual Geometric Mean	60 μg/m^3	75 μg/m^3	60 μg/m^3
	24 hour	100 μg/m^3	260 μg/m^3	150 μg/m^3
Sulfates	24 hour	25 μg/m^3	--	--
Lead	30 Day Average	1.5 μg/m^3	--	--
Hydrogen Sulfide[4]	1 hour	0.03 ppm (42 μg/m^3)	--	--
Hydrocarbons (Corrected for Methane)	3 hour (6-9 a.m.)	--	160 μg/m^3 (0.24 ppm)	Same as Primary Standards
Ethylene	8 hour	0.1 ppm	--	--
	1 hour	0.5 ppm		

[1] California standards are values that are not to be equaled or exceeded.

[2] National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

[3] This standard only applies when the California State ozone or particulate standard is exceeded.

[4] Santa Barbara County has an H_2S regulation limiting ambient levels to 0.06 ppm for 3 minutes.

Source: AeroVironment, Inc. op. cit., p.III.2.

iii. Critical Exposure Fractions

As mentioned above, health effects are assumed to occur only when the critical concentration is exceeded for at least the minimum critical period. Thus, if air quality is so poor as a result of other "background" activities that thresholds are exceeded continuously throughout the entire year, then all increments to ambient concentrations from lease sale #48 production for that year will cause adverse health effects, properly charged against economic benefits. At the other extreme, if air quality is so good that thresholds will never be exceeded during the year even with the lease sale #48 increments, then no additional adverse health effects will occur and no charges should be deducted from economic benefits [13]. As is usual, the reality of the situation lies somewhere between the two extremes.

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[13] The increasing marginal damage costs of air emissions depicted in Figure II.D.1. result in higher costs being charged against new polluters than old polluters. Thus when thresholds are exceeded, the entire cost of increments is charged to offshore development, despite the fact that no damages would occur were it not for the already high level of background activity. Since no charges are levied against the older background polluters, despite their contribution to the damage, persons not familiar with economic theory may sense the evils of price discrimination and suggest that damage costs be averaged among all polluters. But this practice is questionable, as it would distort incentives and lead to higher pollutant levels. The choice is between optimal pollutant levels and some notion of equity between old and new polluters.
For a fuller discussion, see
William J. Baumol and Wallace E. Oates, The Theory of Environmental Policy (Englewood Cliffs, N.J.,: (Prentice Hall, Inc., 1975).

This reality is captured by the critical exposure fraction - a number between 0 and 1. The critical exposure fraction is denoted by tij in Figure II.D.2. and is dimensionless, since its units cancel out. That is, the fraction is critical periods per year divided by total periods per year. As indicated by the subscripts, i and j, the critical exposure fraction must be determined for each of the six threshold combinations of Table II.D.8.

Strictly, since concentration increases are functions of space and time, critical exposure fractions are also. In the following, the time element is suppressed since we consider only the year of peak oil production (1986). In a more detailed analysis, emissions and implied concentration increases would be calculated for each year of production and projections of background ambient concentrations for each year would be utilized to develop a complete schedule of critical exposure fractions.

Emissions from lease sale #48 production are expected to affect three air basins - the South Central Coast, the South Coast, and the San Diego. As will be seen later in this subsection, we estimate the total population of these basins in 1986 to be 14.2 million people of which about 10 million are expected to reside in the coastal counties of Ventura, Los Angeles, and Orange. Of all the counties within the three air basins, these three counties have the poorest air quality.

The element of spatial variation is suppressed in this demonstration analysis by averaging air quality data across monitoring stations in Ventura, Los Angeles, and Orange counties. To the extent that the location of monitoring stations is well correlated with population centers (as common sense would suggest for their siting), this procedure is conservative. This is because it calculates the risks to the 4.2 million people in the remaining counties as if they were also subject to the poorer air quality of Ventura, Los Angeles, and Orange counties.

Table II.D.10. shows the air quality data used to develop ranges for periods over thresholds for the three critical levels of sulphate concentrations (6,9, and 25 ug/m^3). The wide ranges selected are depicted in Figure II.D.5. To the extent that the regulations of the Air Resources Board and the Air Quality Management Districts are successful in improving air quality, actual periods over threshold will be toward the low end of the given ranges.

Table II.D.11. shows the air quality data used to develop ranges for periods over thresholds for critical levels of oxidant and carbon monoxide concentration (392 ug/m^3 O_3, 10,300ug/m3CO) Periods for carbon monoxide are hours during which the moving 8 hour average concentration exceeded the critical level.

Finally, Table II.D.12. shows the ranges in periods per year and the implied critical exposure fractions for the six combinations of pollutants and health effects under consideration. Recall that the fractions are those values called for in the calculation scheme of Figure II.D.2.

Table II.D.10.

Sulphate Ambient Concentrations [1]

Periods Over Thresholds

Daily Average Concentration (ug/m^3)	Number of Days with Concentrations Equal or Greater than Range 1973 [2]	1974	1975 [2]
0.5	361	356	361
5-10	266	258	262
10-15	194	145	151
15-20	135	74	87
20-25	90	33	31
25-	39	18	9

Sources:

(1) Decision Analysis of California Liquefied Natural Gas (LNG), Applied Decision Analysis, Inc., December 20, 1977.

(2) Three Year Summary of California Air Quality, 1973-75. State of California Air Resources Board, Technical Services Division, Air Analysis Branch and EDP Management Section. January 1977.

Notes:

[1] Average of six CHESS monitoring stations in Ventura, Los Angeles, and Orange counties.

[2] These schedules are graphed in Figure II.D.5., using the mid-point of the concentration range.

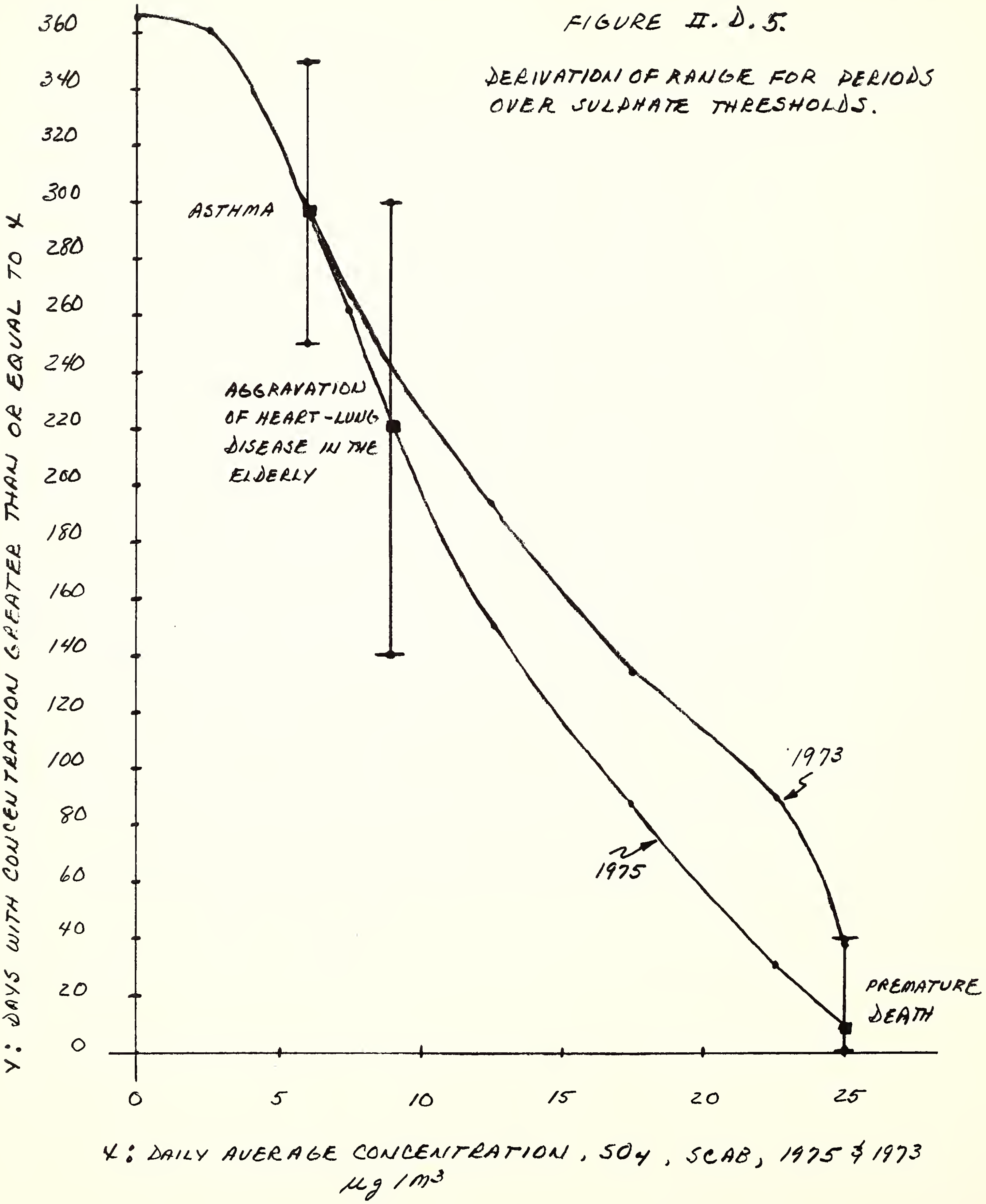

FIGURE II.D.5.

DERIVATION OF RANGE FOR PERIODS OVER SULPHATE THRESHOLDS.

JDR.

Table II.D.11.

Carbon Monoxide and Oxidant Ambient Concentations, Periods Over Thresholds.

County	Number of Stations	Number of Hours over Threshold	Number of Hours Reported	Average Hours/yr. Over Threshold [3]
Carbon Monodixe [1]				
Ventura	2	0	16,734	0
Los Angeles	14	8397	106,564	690.3
Orange	3	1376	24,836	433.0
Total	19	9773	148,134	577.9
Oxidants [2]				
Ventura	5	7	27,736	2.2
Los Angeles	14	833	101,022	72.2
Orange	6	83	48,799	14.9
Total	25	923	177,557	45.5

Source:

Summary of 1976 Air Quality Data: Gaseous Pollutants, California Air Resources Board, Technical Services Division, Air Analysis Branch and EDP Management Section. pp.14-15,18-19.

Notes:

[1] CO threshold - 0 ppm or 10,300 ug/m^3

[2] Oxidant Threshold - .20 ppm or 392 ug/m^3.

[3] $$\frac{\text{Ave. hrs. over threshold}}{\text{yr.}} = \frac{\text{no. of hrs. over threshold}}{\text{no. of hours reported}} \times 8760 \frac{\text{hr.}}{\text{yr.}}$$

This procedure is conservative in proportion to amount by which concentrations during unreported hours (e.g., nights, weekends, holidays) are lower than during reported hours.

Table II.D.12.

Periods per Year over Threshold and Critical Exposure Fractions

Pollutant	Health Effect	Threshold ug/m^3	Critical Period	Periods over Threshold [1]	Critical Exposure Fraction (tij) [2]
Sulphates	Premature Death	25	1 day ave.	0-40 (10)	0.000 - 0.110 (0.027)
	Aggrav. of Heart and Lung Disease	9	1 day ave.	140-300 (200)	0.384 - 0.822 (0.603)
	Asthma Attacks	6	1 day ave.	250-350 (295)	0.685 - 0.959 (0.808)
Carbon Monoxide	Excess Cardiac Deaths	10,341	hrs. when 8 hr. moving ave.exceeds	300-1200 (578)	0.034 - 0.137 (0.066)
Oxidants	Aggrav. of Heart and Lung Disease	400	1 hr.	20-200 (46)	0.002 - 0.023 (0.005)
	Asthma Attacks	400	1 hr.	20-200 (46)	0.002 - 0.023 (0.005)

Notes:

[1] Subjective estimates from data presented and depicted in Tables II.D.10 and 11, and Figure II.D.5. The value in paranthesis is the point estimate obtained from the data.

[2] Divide preceding column by 365 days/yr or 8760 hrs/yr as appropriate.

iv. Dose Response Multipliers

The dose response multipliers are denoted by dji in Figure II.D.2. and are intended to capture the average sensitivity of a population to concentrations in excess of the threshold levels and durations presented above. These multipliers are used to raise the base incident rates (discussed next) for the four health effects under consideration due to increases in pollutant concentration levels.

One weakness of the dose response values utilized herein is that the manner of specifying these values implicitly assumes that each pollutant induces health effects independently - the possible interactive effects of simultaneous exposure to several pollutants is ignored. This fault is not intrinsic to the dose response approach, rather it reflects the inadequate state of knowledge of medical scientists in defining cause and effect relationships between combinations of adverse influences and all types of health effects. If more sophisticated data were available regarding interactions and cumulative effects [14], there would be little analytic difficulty in incorporating such data into a health effects model like that presented here.

These comments can be interpreted as a request for additional research to improve knowledge of dose response relationships. Yet in the absence of such improved quantitative information, analysts performing a decision oriented analysis are obliged to proceed with the best data available. As noted in Chapter I, this procedure provides the decision-maker with at least some costs for comparison with economic benefits, and as such is superior to undocumented or emotional predictions of impending doom or indeed, to avoiding the air quality issue entirely.

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[14] For a discussion of the uncertainties and problems associated with interactive and cumulative exposure analyses, see: Report on the Costs and Effects of Chronic Exposure to Low-level Pollutants in the Environment, Subcommittee on the Environment and the Atmosphere of the Committee on Science and Technology, U.S. House of Representatives. July 1976.

Table II.D.13. presents the ranges and point estimates for dose response multipliers used herein.

Table II.D.13.

Dose Response Multipliers

Pollutant	Health Effect	Range, (dji) [1] [2] (Point Estimate)
Sulphates	Premature Deaths	0.00125 - 0.00500 (0.00250)
	Aggravation of Heart and Lung Disease	0.00750 - 0.03000 (0.01500)
	Asthma Attacks	0.01700 - 0.06800 (0.03400)
Carbon Monoxide	Excess Cardiac Deaths	0.00002 - 0.00008 (0.00004)
Oxidants	Aggravation of Heart	0.00010 - 0.00040 (0.0002)
	Asthma Attacks	0.00010 - 0.00040 (0.0002)

Sources:

1. A Decision Analysis of California Liquefied Natural Gas, Applied Decision Analysis, Inc. December 20, 1977.
2. Finklea, et. al., Estimates of Public Health Benefits and Risks Attributable to Equipping Light Duty Motor Vehicles with Oxidation Catalysts. (National Environmental Research Center, EPA. Research Triangle Park, Feb. 1975).
3. Nelson, et. al., *op. cit.*

Notes:

[1] units: $1/\Delta ug/m^3$

[2] Ranges derived by halving and doubling point estimates obtained from sources.

v. Base Incident Rates

Table II.D.14 presents the data used herein for base incident rates of the four health effects under consideration. Because uncertainty regarding these variables is low relative to that for other model variables, ranges are not employed - the point estimates of the Table are used throughout.

Table II.D.14

Base Incident Rates [1]

Health Effect	Point Estimate, (bj) cases/person-year
Aggravation of Heart and Lung Disease [2]	2.17
Asthma Attacks [3]	2.19 x 10-1
Premature Deaths [4]	1.02×10^{-2}
Excess Cardiac Deaths [5]	4.75×10^{-3}

Sources:

1. Air Quality and Stationary Source Emission Control, The Commission on Natural Resources of the National Academy of Sciences, National Academy of Engineering, and National Research Council. (A Report for the Committee on Public Works, United States Senate). March 1975. p.608.
2. Finklea, et. al., *op. cit.*

Notes:

[1] The base incident rates are based on national statistics. Data for the population of southern California was not available. Finklea also calculates oxidant dose response multipliers and base incident rates for chest and eye discomfort, cough, and headaches, which have been neglected in this demonstration.

[2] This figure refers to cases among the elderly (over 65), who are reported to constitute 11% of the general population. Of these elderly, 27% are reported susceptable and experience aggravation one day of five (20%). The product of these percentages multiplied by 365 days/yr yields the value 2.17.

[3] It is reported that three percent of the general population are susceptible to asthma attacks and that these individuals experience an attack once every fifty days. (.03).(.02).365 = 0.219.

[4] The sources report yearly death rates due to sulphates of between 2.58 and 2.80 per hundred thousand of the general population.

[5] It is reported that 0.26% of the general population are susceptible to carbon monoxide induced cardiac deaths and that one mortality occurs daily among 200 of these individuals. (.0026)(.005)(365) = .00475.

iv. Population

Table II.D.15 shows population figures and recent growth rates for the counties within the three air basins of concern. The last column contains estimates of population for 1986, the year of peak oil production, which were calculated by simple extrapolation. These figures are used in the demonstration to calculate health effects over the production lifetime of the lease sale #48 tracts. Actually, the conservative assumption is made that the 14,200,000 people within the three air basins will be exposed to the more severe concentrations present in Ventura, Los Angeles, and Orange counties, since the data of Table II.D.12 on critical exposure fractions was calculated with respect to these three counties.

While there is some uncertainty in the population estimates, it is small relative to that for the other model variables. That is, it is most unlikely that the population will be half or double that estimated. Consequently, a range for population is not specified - rather the point estimate of 14,200,000 persons is used throughout.

Table II.D.15

Population and Population Growth Rates.

Area	County	Population (1 July 1977)	Percent Change (1972-1977)	1986 Estimate*
South Central Coast Air Basin (SCCAB)	Santa Barbara	289,000	6.9	312,900
	San Luis Obispo	136,500	21.0	170,900
	Ventura	468,900	15.7	557,200
	Total	894,400	13.7	1,041,000
South Coast Air Basin (SCAB)	Los Angeles	7,340,700	0.7	7,402,400
	Orange	1,799,700	17.6	2,179,800
	Riverside	738,200	16.9	887,900
	San Bernadino	569,200	6.8	615,600
	Total	10,447,800	5.1	11,085,700
San Diego Air Basin (SDAB)	San Diego	1,679,000	17.9	2,039,600
	Total	1,679,000	17.9	2,039,600
Grand Total		13,021,200	7.3	14,166,300

Source: Population Studies, State of California, California Department of Finance. May, 1978.

* Calculated by simple extrapolation for the purposes of this demonstration.

vii. Valuing Health Effects

The techniques and data of the preceding are sufficient to permit the calculation of ranges and point estimates for the four health effects under consideration. Although the specification of a relationship between pollutant emissions from lease sale #48 oil and gas operations and induced health effects has considerable utility in itself, the final step for a decision oriented analysis has yet to be taken. The purpose of this subsection is to present the value data which allows direct comparison of health effects and economic benefits.

The preceding analysis was subjective by virtue of selecting a model structure, and ranges and point estimates for the model parameters. Nevertheless, the subjective character could, in principle, be eliminated by a massive research effort resulting in a definitively correct and accurate model for estimating health effects from offshore oil and gas activities. In contrast, the act of valuing health effects is inherently subjective - no amount of research can produce a definitively correct and accurate set of values, accepted by all individuals and groups.

Analogous to the discussion accompanying Figure II.D.1, the cost of an additional case of illness is the minimum of

- an individual's or group's willingness to pay for prevention, which should be proportional to damage suffered as a result of illness, and
- the actual cost of prevention.

If the actual cost (supply price) is less than the price willingly paid (demand price), then preventive activities will occur, yielding a surplus [15] shared by the individual or group and the supplier roughly equal to the difference between the two prices times the number of cases prevented. In this case, the cost assigned to the source of the health effect and the prevention activity (as a joint enterprise) is the cost of prevention - the lower of the damage and prevention cost. Conversely, if the supply price of prevention exceeds the demand price, then prevention will not occur. The cost assigned to the source of the health effect is the damage cost - again the lower of the damage and prevention costs.

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[15] For a more complete discussion of producers' and consumers' surplus, see section I.A.1.

These arguments show that the willingness to pay for prevention represents an upper bound on the cost assigned to the source. But several questions remain. How are damage costs to be assessed? Whose concept of damages is appropriate for use in this demonstration?

There are two candidate techniques for assessing the amount an individual or group would willingly pay to prevent an additional case. The first and most direct way is to ask the individual or group, and the second or indirect way is to deduce the value of preventing another case from past expenditures. Because of the sensitivity of the public to trade-offs between health and dollars, officials rarely choose to make these value judgments directly. More useful information can be garnered via the indirect route.

For example, data exists regarding agencies' expenditures for highway safety equipment (e.g. guardrails, lighting, medians, etc.) and before and after casualty rates. This data can be used to infer the value placed on preventing each casualty by the agencies. By considering simultaneously expenditure and effect data for all types of health, safety, and welfare public projects, a set of "societal values" can be obtained. Table II.D.16. shows the values used for the purposes of this study:

Table II.D.16

Societal Values for Health Effects [1]

Effect	Low	Medium	High
Premature Death	$15,000	$30,000	$90,000
Aggravation of Heart and Lung Disease	10	20	60
Asthma Attack	5	10	30

Source:

Air Quality and Stationary Source Emission Control. The Commission on Natural Resources of the National Academy of Sciences, National Academy of Engineering, and National Research Council. (A Report for the Committee on Public Works, United States Senate). March 1975.

Notes:

[1] The source states only the medium value. The low value set is simply one half the medium set and the high value set is simply three times the medium set. These values are presumably national values and do not account for whatever regional variations that may exist.

It must be emphasized that these values are only those suggested by the Commission on Natural Resources for use in national decision-making involving public funds. There is, of course, no requirement that agencies of the federal government actually employ these values. However, decisions by agencies which require that a tradeoff be made between expenditures and adverse health effects, inevitably imply a set of dollar values on health effects. Furthermore, it can reasonably be argued that the values of all agencies should be similar if not equal, since if this were not the case, then a reallocation of funds among agencies would reduce the net number of adverse health effects.

States and localities may, of course, value adverse health effects more or less than the figures of Table II.D.16. For example, it is reasonable to expect that a locality with a disproportionate number of elderly taxpayers would attach higher costs to and so be willing to spend more to prevent pollution induced diseases than the national norm. However, in a bargaining situation, other parties would likely demand evidence of the validity of irregular values in the form of prior expenditure and effect data.

viii. Health Effects and Their Costs - Deterministic Calculations

Lease sale #48 air pollution induced health effects and their costs are presented in Table II.D.17. The calculations were made separately for oil and gas activities for 1986 and on a per unit of production basis. Note that the aggravation of heart and lung disease is by far the most serious of the effects considered, representing 88% of the total estimated health damages due to oil and gas operations. The increased incidence of asthma attacks makes up the remainder, with premature deaths due to sulphates and carbon monoxide being insignificant on a cost basis.

The estimated number of premature deaths in 1986 due to oil and gas operations is two. Assuming 1986 is a representative year in terms of ambient air quality, estimated premature deaths over the productive life of the tracts, calculated in proportion to production, would amount to 19. While this is certainly a grisly finding, it must be placed in perspective by noting that it refers to a 30 year period and a population of over 14 million people. Over the same period, modest expenditures for highway safety improvements in the Los Angeles area would easily save more than this number of lives.

It must be emphasized that it is entirely improper to interpret the ranges as representing uniform distributions - to infer that any point in the range is equally likely. In fact, the actual costs will inevitably lie close to the estimates shown in parantheses beneath the ranges. Deterministic aggregate health cost estimates per unit of production and over the duration of production are presented in subsection D.2.e along with material and vegetation damages.

Table II.D.17.

Lease Sale #48 Air Pollution Induced Health Effects and Their Costs (Deterministic Calculations for 1986 and Per Barrel/Thousand Cubic Feet)

Part A. Oil Operations: (q = 220 Mbbl/day for 1986).

Health Effect	Pollutant Source	Cases in 1986 [1]	Cost in 1986 [2] thousands of dollars	Cost per Barrel [3] dollars
● aggravation of heart and lung disease in the elderly	sulphates	18 - 377,720 (28,421)	$0. - 22,663. (568.)	$0. - 0.282 (0.007)
	oxidants	0 - 122,700 (13,945)	0. - 7,362. (279.)	0. - 0.092 (0.003)
	combined	18 - 500,420 (42,366)	0. - 30,025. (847.)	0. - 0.374 (0.011)
● asthma attacks in the general population	sulphates	72 - 100,891 (8,283)	0. - 3,027. (83.)	0. - 0.038 (0.001)
	oxidants	0 - 12,400 (141)	0. - 372. (1.)	0. - 0.005 (0.)
	combined	72 - 113,291 (8,424)	0. - 3,399. (84.)	0. - 0.043 (0.001)
● premature deaths in the general population	sulphates	0 - 40 (0.95)	0. - 3,600. (29.)	0. - 0.013 (0.)
● excess cardiac deaths in the elderly	carbon monoxide	0 - 12 (0.57)	0. - 1.080 (17.)	0. - 0.013 (0.)
● total costs	combined	-	$0. - 38,104 (977.)	$0. - 0.475 (0.012)

Part B. Gas Operations: (g = 260 MMcf/day for 1986).

	Health Effect	Pollutant Source	Cases in 1986 [1] range(expected)	Cost in 1986 [2] thousands of dollars	Cost per Mcf [3] dollars
●	aggravation of heart and lung disease in the elderly	sulphates	27 - 190,000 (16,408)	\$ 0. - 11,400. (328)	\$ 0. - 0.120 (0.003)
		oxidants	0 - 20,135 (2,789)	0. - 1,208 (56)	0. - 0.013 (0.001)
		combined	27 - 210,135 (19,197)	0. - 12,608 (384)	0. - 0,133 (0.004)
●	asthma attacks in the general population	sulphates	109 - 50,750 (4,810)	0. 1,523 (48)	0. - 0.016 (0.001)
		oxidants	0 - 2,035 (28)	0. - 61 0	0. - 0.001 (0.)
		combined	109 - 52,785 (4,838)	0. - 1,584 (48)	0. - 0.017 (0.001)
●	premature death in the general population	sulphates	0 - 20 (0.55)	0. - 180 (17)	0. - 0.002 (0.)
●	excess cardiac deaths in the elderly	carbon monoxide	- -	- -	- -
●	total costs	combined	-	\$0. - 14,372 (449)	\$0. - 0.151 (0.005)

Notes:

[1] The tremendous range derives from making calculations with lowest and highest values of the seven major (and numerous other minor) model variables. Consequently, it is improper to represent any value within the ranges as being equally likely-outcomes near the point estimates are "very strongly expected." See the discussion of subsection D.2.f for the techniques and results of probabilistic analyses.

[2] Again, the high estimates use the high values of Table II.D.16, the point estimates the middle values, and the low estimates the low values of Table II.D.16.

[3] These figures are obtained by dividing the figures of the preceding column by the production rate (220×10^3 or 260×10^3) and by 365 days/yr.

e. Material and Vegetation Damages.

In addition to inducing adverse health effects, pollutant emissions from lease sale #48 production can be expected to cause damage to material and residential property in the form of corrosion, discoloration, and increased maintenance costs and to vegetation in the form of reduced growth rates. Perhaps because of the number and variety of possible effects combined with the relative insignificance of each single effect, data on material and vegetation damages is more scarce than that for health effects. Nevertheless, the desire for completeness in this demonstration of a decision-oriented analysis requires that some estimate of these damages be made.

Table II.D.18 presents EPA estimates of national emissions and associated material and vegetation damages for 1968. Since the relationship between emissions and these costs is not specified (in contrast to the health effects model of the preceding subsection), a rather simplistic model is used herein for the prupose of rough estimation. That is, incremental damages are assumed proportional to incremental emissions and national data is substituted for lacking southern California data.

Valid criticisms of these assumptions can be expected from air pollution scientists, whose purpose is to predict as accurately as possible. Yet from a decision perspective, this technique permits an estimate of costs which is probably correct to within an order of magnitude. If the decision proved sensitive to the level of pollution induced material and vegetation damages, then a second, more accurate analysis would be required.

Table II.D.19 shows the costs in 1986 and on a per unit of production basis for material and vegetation damages due to four types of pollutant emissions associated with lease sale #48 oil and gas operations. Damages to vegetation are seen to be insignificant. Expected damages to materials are due to oxidants, and are nearly equal to the dominating sulphate induced health effect damages.

Table II.D.18

National Pollutant Emissions Damage Costs, 1968

Pollutant [1]	Emissions million kg	Materials and Residential Property million $	Materials and Residential Property $/kg	Vegetation million $	Vegetation $/kg	Health [2] million $	Health [2] $/kg
SO_x	30,100	5,010	0.166445	13	0.000432	3,272	0.108704
$RHC-O_3$	29,000	1,127	0.038862	60	0.002069	-	-
NO_x	18,700	732	0.039144	40	0.002139	-	
TSP	25,700	3,083	0.119961	7	0.000272	2,788	0.108482

Source:

Cost of Air Pollution Damage: A Status Report, U.S. Environmental Protection Agency. pp. 59,61.

Notes:

[1] No damages to materials and vegetation are reported due to CO emissions.

[2] Using the calculation technique of Note [1], Table II.D.19, health effects cost due to sulphur oxides and particulate emissions can be found. The results per unit of production and for 1986 are:

Pollutant	Oil Operations 1986-1000$	Oil Operations $ /bbl	Gas Operations 1986-1000$	Gas Operations $ /mcf
SO_2-SO_4	8 - 394 (86)	0.000 - 0.005 (0.001)	12 - 198 (50)	0.000 - 0.002 (0.001)
TSP	8 - 167 (40)	0.000 - 0.002 (0.000)	no emissions	

These TSP health cost estimates are used in the summary table of section II.D.2.a. Note that the sulphate cost estimates given by this simple procedure are much lower than those developed in the preceding section.

Table II.D.19

Material and Vegetation Damages [1] Deterministic Calculations

	Pollutant	Material and Residential Property		Vegetation	
		1986-$1000	per bbl/mcf - $	1986-$1000.	per bbl/mcf - $
Oil Operations:					
	SO_2-SO_4	13 - 603 (132)	0.000 - 0.008 (0.002)	0 - 1 (0)	0.000 - 0.000 (0.000)
	RHC-O_3	18 -2738 (562)	0.000 - 0.034 (0.007)	1 - 146 (30)	0.000 - 0.002 (0.000)
	NO_x	23 - 398 (98)	0.000 - 0.005 (0.001)	1 - 22 (5)	0.000 - 0.000 (0.000)
	TSP	9 - 185 (44)	0.000 - 0.002 (0.001)	0 - 0 (0)	0.000 - 0.000 (0.000)
Gas Operations:					
	SO_2-SO_4	19 - 303 (76)	0.000 - 0.003 (0.001)	0 - 1 (0)	0.000 - 0.000 (0.000)
	RHC-O_3	28 - 450 (112)	0.000 - 0.005 (0.001)	2 - 24 (6)	0.000 - 0.000 (0.000)
	NO_x	83 -1328 (332)	0.001 - 0.014 (0.003)	5 - 73 (18)	0.000 - 0.001 (0.000)
[2]	TSP	- -	- -	- -	- -

Notes:

[1] Method of Calculation: Let h be the dollars per kilogram cost figure of Table II.D.18. The expected cost per unit of production is given by:

$$h\ (\$/\text{kg}) \cdot e[(\text{kg/hr})/(\text{Mbbl/day})] \cdot 24\,(\text{hours/day}).\ 1000\ (\text{bbl/Mbbl}))$$

The e's are given in Table II.D.4. The ranges shown above the expected cost are found by halving and doubling the h's and by using the ranges for emission factors given in Table II.D.4. The ranges and point estimates of 1986 costs are obtained by multiplying the costs per unit of production by the yearly production rates corresponding to q = 220 Mbbl/day and g = 260 MMcf/day. Also note that the figures shown in this table have been rounded to the nearest mill or thousand dollars, as appropriate.

[2] No significant particulate emissions are expected from gas operations.

f. Deterministic Versus Probabilistic Analyses

Table II.D.20 presents a summary of the deterministic calculations of lease sale #48 air pollution costs. The ranges and point estimates of the Table and the preceding subsections correspond to three distinct deterministic calculations of the best, "most likely," and worst cases. The most likely point estimates shown in parentheses are not expected values that would result from any probabilistic analysis that could reasonably be associated with the assumed ranges.

The purpose of this section is to demonstrate the effect of performing a probabilistic analysis of air pollution costs. By assuming that the ranges and point estimates of the preceding correspond to the extremes and median of appropriately stepped uniform distributions, it is possible to calculate expected air pollution costs, as shown in Table II.D.21. Because the assumed distributions are skewed to higher values of the model parameters, the expected costs are invariably higher than the point estimates of the preceding. The aggregate cost of health, material, and vegetation damage increases from \$.022 to \$.036 per barrel and from \$.010 to .014 per thousand cubic feet. Although these increases seem significant when stated in percentage terms (40 - 65%) they are hardly significant to change the decision from a national perspective. However, these considerations are important from a state or local perspective, especially for the purpose of guiding negotiations over redistributions.

The final portion of this section shows that regardless of the parameter distributions assumed, the structure of the models implies that the final results will with high probability be near the point estimates and expected values calculated.

Table II.D.20.

Summary of Lease Sale #48 Air Pollution Costs.
(Deterministic Analysis)

Part A: Per Unit of Production

Pollutant	Oil ($/bbl)				Gas ($/mcf)			
	Health	Materials	Vegetation	Total	Health	Materials	Vegetation	Total
SO_x	0. - .365 (.008)	0. - .008 (.002)	0. - .000 (.000)	0. - .373 (.010)	0. - .373 (.004)	0. - .003 (.001)	0. - .000 (.000)	0. - .141 (.005)
CO	0. - .013 (.000)	N/A	N/A	0. - .013 (.000)	0. - .000 (.000)	0. - .000 (.000)	0. - .000 (.000)	0. - .000 (.000)
RHC	0. - .097 (.003)	0. - .034 (.007)	0. - .002 (.000)	0. - .133 (.010)	0. - .014 (.001)	0. - 005 (.001)	0. - ,000 (.000)	0. - .019 (.002)
NO_x	N/A	0. - .005 (.001)	0. - 000 (.000)	0. - .005 (.001)	N/A	0. - .014 (.003)	0. - .001 (.000)	0. - .015 (.003)
TSP	0. - .002 (.000)	0. - .002 (.001)	0. - 000 (.000)	0. - .004 (.001)	0. - .000 (.000)	0. - .000 (.000)	0. - .000 (.000)	0. - .000 (.000)
Totals	0. - 477 (.011)	0. - .049 (.011)	0. - .002 (.000)	0. - .528 (.022)	0. - .138 (.005)	0. - .022 (.005)	0. - .001 (.000)	0. - .165 (.010)

Notes:

[1] All values rounded to nearest mil ($0.001). See subsection f for expected values and probabilistic analysis.

[2] N/A means damages not considered because they are reported as non-existent or trivial, or because available data was incompatible with the analysis technique.

[3] All entries include a probable range and a deterministic point estimate in parantheses.

Part B: Discounted Total Cost Over Production Lifetime. (thousands of dollars).

	Discount Rates			
	0.00	0.05	0.10	0.15
Oil Operations	0 - 377,520 15,730	0 - 226,619 9,442	0 - 146,866 6,119	0 - 100,475 4,186
Gas Operations	0 - 141,900 8,600	0 - 85,151 5,161	0 - 55,168 3,344	0 - 37,733 2,287
Totals	0 - 519,420 24,330	0 - 311,770 14,603	0 - 202,034 9,463	0 - 138,208 6,473

Notes:

[1] Discounting based on production rates specified in Table II.C.2, with remaining production spread over eight additional years.

That is, the distribution on air pollution costs will have a long, narrow "tail" at higher values, and hence it is entirely improper to interpret the preceding as implying that any outcome within the ranges is equally likely.

If published data contained only one estimate of a model parameter, then that estimate was used as the most likely point estimate. In the absence of better information, a range was established by arbitrarily halving and doubling the estimate. By interpreting the estimate as the median of a stepped uniform distribution, density functions like those shown in Figure II.D.6 are implied. In the Figure, αa and βa denote the range and a is the point estimate. The median of the random variable ao (denoted ao*) is a by construction, and the mean of ao (denoted $\bar{a}o$) can be calculated to be $(a/4)\cdot(2+\alpha+\beta)$.

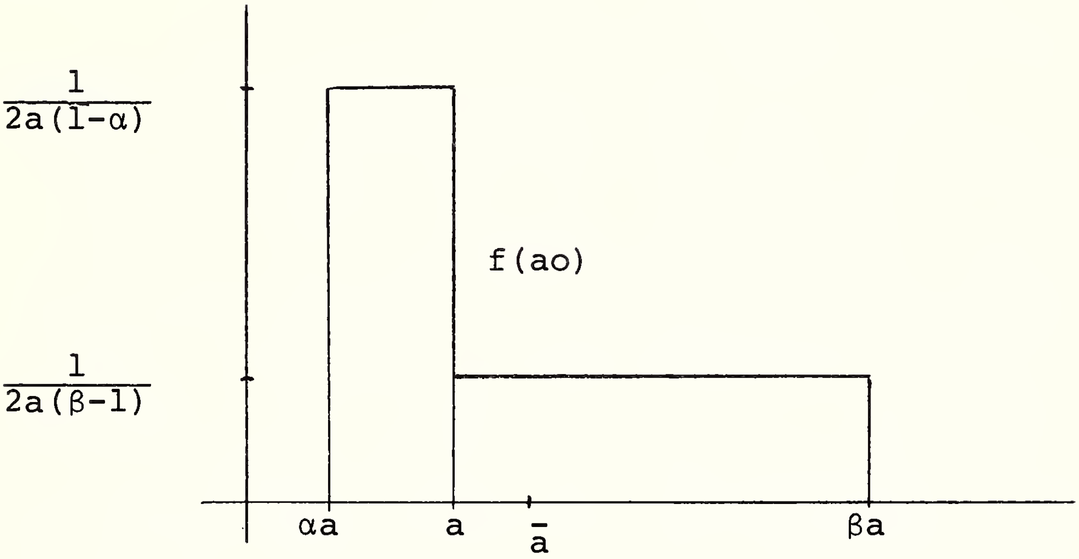
From a probabilistic perspective, the point estimates on costs are actually the products of medians, i.e., of other point estimates. In a deterministic analysis (where the point estimate is assigned probability one), the product of these point estimates leads to a correct and well-defined point estimate of the result.

However, if the point estimates are interpreted as medians and thereby associated with the ranges and the distributions of the Figure, then the product of the medians will be lower than both the median and mean of the product. Recall that in general the median of the product is not equal to the product of the medians but that the mean of the product is always the product of the means.

The formula above along with the first order homogeneity characteristic of the models permits calculation of the means of the distributions on both model parameters and final results. A sample calculation is carried out below for oil induced aggravation of heart and lung disease. The results of all such calculations for health effects are presented in Table

Figure II.D.6

Implicit Probability Distributions on Model Parameters



$$f(ao) = \begin{cases} \dfrac{1}{2a(1-\alpha)} & \alpha a \leq ao \leq a \qquad (o \leq \alpha < 1) \\[2ex] \dfrac{1}{2a(\beta-1)} & a \leq ao \leq \beta a \qquad (1 < \beta < \infty) \end{cases}$$

median: $ao^* = a$

mean : $\bar{ao} = \int_{\alpha a}^{\beta a} ao \; f(ao) \; dao = \frac{a}{4} \, (2 + \alpha + \beta)$

II.D.21 [16].

The air pollution models employed herein consists of the sums and products of several parameters, which must in all generality be considered random variables. In the health effects model, ranges and implicit random variable status are assigned to four parameters (e, λ, t, d, and γ also for RHC), whereas point estimates were assumed throughout for g, q, b, and p and the cost of health effects.

For the sulphate portion, the affected variables are e, λ, t, and d. The product of the ratios of the means to the medians yields the ratio of the mean of the product to the product of the medians, i.e., the point estimates of the deterministic analysis. Thus:

$$SO_4:\ \underset{e}{\frac{0.46}{0.41}} \cdot \underset{\lambda}{\frac{0.049}{0.045}} \cdot \underset{t}{\frac{0.603}{0.603}} \cdot \underset{d}{\frac{0.0169}{0.1500}} = \underset{h}{1.38}$$

Thus, if distributions like those of Figure II.D.6 were assumed for these variables, and if a probabilistic analysis were performed, the expected per barrel cost of oil induced, sulphate induced increased cases of heart and lung disease would be 1.38 times greater than the deterministic results of Table II.D.20. This corresponds to a value of $.010/bbl rather than $.008/bbl.

The calculation for the oxidant portion is similar.

$$OX:\ \underset{e}{\frac{8.44}{7.50}} \cdot \underset{\lambda}{\frac{0.045}{0.040}} \cdot \underset{\gamma}{\frac{0.36}{0.35}} \cdot \underset{t}{\frac{0.009}{0.005}} \cdot \underset{d}{\frac{0.00023}{0.00020}} = \underset{h}{2.69}$$

Hence the expected per barrel cost resulting from a probabalistic analysis using distributions like those of Figure II.D.6. for oil-induced, oxidant-induced increased cases of heart and lung disease would be 2.69 times the deterministic value. This would correspond to a value of $.009/bbl rather than $.003/bbl.

---

[16] We have some reservations regarding these expected value results because of the arbitrariness of the assumed distributions. Had we the resources and mandate to poll experts regarding their view of the proper distributions, we would place more confidence in these results.

Table II.D.21.

Summary of Lease Sale #48 Expected Air Pollution Costs
(Probabilistic Analysis)

Part A: Per Unit of Production

Pollutant	Oil ($/bbl)				Gas ($/mcf)			
	Health	Materials	Vegetation	Totals	Health	Materials	Vegetation	Totals
SO_x	.012	.002	.000	.014	.006	.001	.000	.007
CO	.000	N/A	N/A	.000	.000	.000	.000	.000
RHC	.009	.009	.000	.018	.002	.001	.000	.003
NO_x	N/A	.002	.000	.002	N/A	.004	.000	.004
TSP	.001	.001	.000	.002	.000	.000	.000	.000
Totals	.022	.014	.000	.036	.008	.006	.000	.014

Notes:

[1] All values rounded to nearest mil ($0.001). See subsection a for deterministic result.

[2] N/A means damages not considered because they are reported as non-existent or trivial or because available data was incompatible with the analysis technique.

Part B: Discounted Expected Total Cost Over Productive Lifetime (thousands of dollars)

	Discount Rates			
	0.00	0.05	0.10	0.15
Oil Operations	25,740	15,450	10,010	6,850
Gas Operations	12,040	7,230	4,680	3,200
Totals	37,780	22,680	14,690	10,050

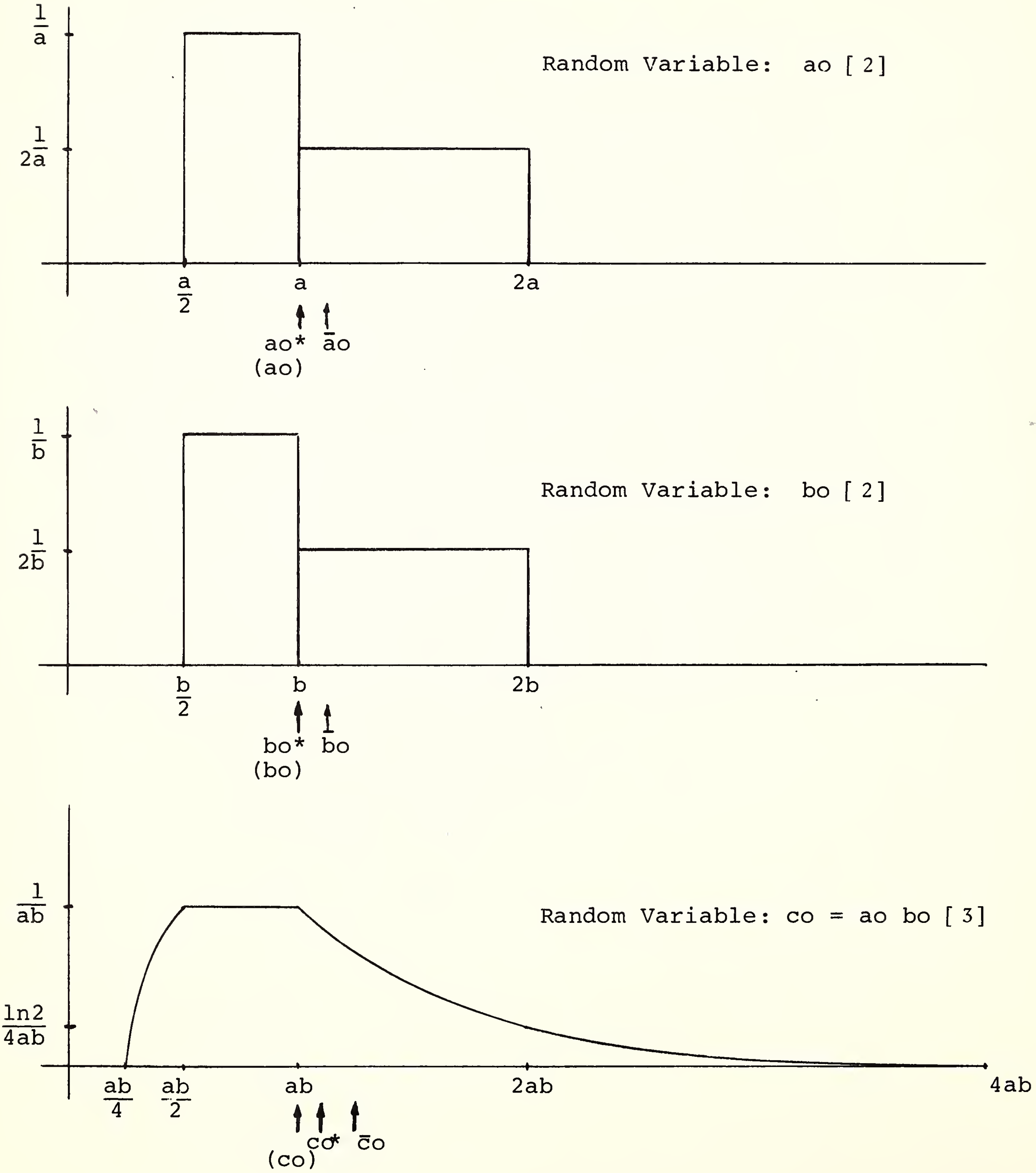
The final topic of this brief discussion of probabilistic techniques is that of presenting the characteristics of the distribution of a product of random variables, the factors of which have distributions like those shown above. In Figure II.D.7, three distributions are shown corresponding to independent factors ao and bo and their product co = aobo. The Figure and associated calculations are directly applicable to the material and vegetation damages models since they are the product of only two ranged parameters.

(co) corresponds to the point estimates of this analysis, being the product of medians; co* is the median of the product - a vertical line through the median divides the area beneath the curve in two; and $\bar{c}o$ is the mean or expected value of the distribution - the balance point of a uniformly thick form in the shape of the distribution.

Although this Figure depicts the product of just two variables, the source of the large ranges in this analysis evident. Note also that the three quantities (co), co*, and $\bar{c}o$ are all very much to the low end of the range. The "long tail" phenomenon and the location of indicator quantities near the low end of the range would be even more pronounced with more factors - as is the case with the health effects model.

Figure II.D.7

Interpretation of Ranges and Point Estimates [1]



Notes:

[1] These figures depict the density functions of continuous random variables, and are completely analogous to the familiar bell shaped curve of the normal distribution. The probability that the random variable, χo, takes on a value less than or equal to χ (denoted $F(\chi o \leq \chi)$ is given by the area beneath the density function (denoted $f(\chi)$) from the minimum value of χo up to χ.

Hence: $F(\chi o \leq \chi) = \int_{\chi o\ \min}^{\chi} f(\chi o)\, d\chi o$. In the diagrams, the mean or expected value of the density function is denoted with a "bar" superscript, while the median is denoted with an asterisk. Recall that the mean is the "balance point" of the density function and is given by:

$$\bar{\chi} = \int_{\chi o\ \min}^{\chi o\ \max} \chi o f(\chi o)\, d\chi o.$$

Recall also that the median is the value such that there is a 50-50 chance that the random variable is above or below the median value. Hence χ^* is such that

$$F(\chi o \leq \chi^*) = 0.5.$$

[2] The density function for ao is given below. The expression for bo is found by replacing a and ao with b and bo respectively.

$$fa\ (ao) = \begin{cases} 1/ao & a/2 \leq ao \leq a \\ 1/2\ ao & a \leq ao \leq 2a \end{cases}$$

[3] The density function for co = ao bo is found by an appropriate (and somewhat tedious) integration of the joint density on ao and bo. The expression for the curve drawn in the Figure, fc (co), is:

$$\begin{array}{ll} (1/ab) \cdot \ln\ (4co/ab) & ab/4 \leq co \leq ab/2 \\ (1/ab) \cdot \ln\ 2 & ab/2 \leq co \leq ab \\ (3/4ab) \cdot [\ln\ (ab/co) + (4/3) \cdot \ln(2)] & ab \leq co \leq 2ab \\ (1/4ab) \cdot \ln(4ab/co) & 2ab \leq co \leq 4ab \end{array}$$

Note that the median of this distribution is slightly greater than the product of the medians of the factors and that the mean of the product is the product of the means. The point estimates of the deterministic calculations are products of the point estimates of the factors and so are less than both the mean and median of the calculated product distributions.

3. Oil Spills

a. Introduction and Summary

An extremely simple model is used to estimate the number, volume, and cost of major oil spills arising from lease sale #48 operations. It is estimated that 5.1 major spills will occur amounting to 207,000 bbls in total. Although ecological changes are neglected, each spilled barrel is assumed to cause $344 worth of market valued and external economic costs - the value being based on the cost of the 1969 Santa Barbara Channel blowout. These figures imply a crude estimate of oil spill costs in the amount of $0.100 per barrel produced. Using this figure and the assumption that spills occur in proportion to production, one has the following Table:

Table II.D.22

Economic Costs of Lease Sale #48 Major Oil Spills

Discount Rate	Aggregate Cost (thousands of dollars)
0.00	71,500
0.05	42,900
0.10	27,900
0.15	19,300

We conjecture that between 1/3 and 2/3 of these costs are borne by the responsible parties, petroleum consumers, and the tax-paying public, and that the remainder goes uncompensated and accrues to the localities affected by the spill.

b. Calculations

i. Overview of Techniques

The ultimate goal of a decision-oriented oil spill analysis is that of assessing the probability distribution on costs resulting from spills in order that these costs may be compared with the costs and benefits of other effects of the lease sale. As noted throughout this demonstration, the first step is the construction of a simple, yet plausible model primarily for the purpose of placing bounds on the results. If the decision proves insensitive to the worst case, then the analysis terminates at the "back of the envelope" stage. If the decision is sensitive to the worst case, then more resources must be allocated to improve the model structure, to assess distributions on critical parameters, and to perform a complete probabilistic analysis.

Decision analysts value models in proportion to the values of the information generated by the model - and the value of this information is well-defined when related to a particular decision. Scientists value models in proportion to the accuracy of the information generated. If model A depicts reality better than model B, then A is everywhere preferred to B, despite considerations of expense or complexity. The modelling objectives of decision analysts and scientists rarely coincide - yet each has its place.

From a scientific perspective, damages due to oil spills could, in theory, be modelled much like air pollution damages. Analogous to the emissions portion of the previous section, one would first obtain estimates of the number, size, location, and timing of oil spills. To account for uncertainties in the actual production plan, a network approach like that of the previous section could be employed. Analogous to the concentration portion of the previous section, joint distributions on the size and timing of spills for every grid location along with the hydrographic and meteorological data would constitute input data for a complex model which would yield pollutant concentrations on shore, on the surface, and in the water column. Ideally, dose response models could be developed which would describe the effects of the various crude fractions on all biological species and materials of concern (the distribution of which would also have to be specified over space and time). The result of all this would be a set of probability distributions on damages. The final step would involve valuing the potential damages. Unfortunately, techniques for valuing changes in ecology are all but non-existent, and the time and cost required to develop such a model could not be justified for the purpose of assisting with one decision. (Basic research in this area is justified if a model results which could easily be applied to a set of similar decisions.)

ii. The Number and Volume of Major Oil Spills

In contrast to the model described above, the technique employed herein to estimate oil spill damages is extremely simple. As regards timing, we assume that spills will occur in proportion to rates of production [17]. The location parameter is suppressed since we calculate the aggregate volume of oil spilled for all the tracts.

The total quantity of oil spilled over the duration of production is a random variable (denoted V_o) which depends on two others: the number of spills over the life of production (denoted N_o) and the size of these spills (denoted S_o).

That is,

$$V_o = \sum_{i=1}^{N_o} S_{oi}.$$

Published data generally distinguishes three categories of spills sizes: less than 50 bbls, between 50 and 1000 bbls, and greater than 1000 bbls. Only major spills of greater than 1000 bbls are considered here, because these spills account for the vast majority of oil spilled from oil production and transportation operations, and because it is assumed that the abruptness and magnitude of these spills makes them the cause of the most severe ecological and economic damages [18].

---

[17] In order to preserve simplicity, we have not sought to improve this assumption, which in principle, could be modified to account for the amount, duration, and frequency of transfer operations. Timothy Wyant and James R. Slack, An Oilspill Risk Analysis for the Eastern Gulf of Mexico (Proposed Sale 65) Outer Continental Shelf Lease Area. (U.S. Geological Survey: Open File Report 78-132, p.3).

[18] The rate of natural crude oil seepage from Coal Oil Point off of Santa Barbara, has been estimated at 40 - 670 bbl/day. Except for the immediate vicinity, the ecology of the general area seems to have adjusted adequately. (OPR, *op. cit.*, p.52).

Thus, using lower case symbols to represent the total volume, number, and size of major oil spills, we have:

$$v_o = \sum_{i=1}^{n_o} s_{oi}.$$

A priori, there is no reason to expect the distribution on the size of major oil spills arising during the course of lease sale #48 operations to differ from the historical size distribution [19].

In 1974, the Council on Environmental Quality published data [20] from which the mean size of major spills ($\bar{s}_o$) can be calculated to be 40,500 bbls. For the purpose of simplicity, we shall use this mean value in place of the distribution on s_o. The substantive effect of this practice is to reduce the variance of the distribution on v_o that we calculate, relative to the formula above. The analytic effect is that the distribution on v_o becomes a scale transformation (i.e., a simple multiple) of the distribution on n_o, rather than a function of the joint distribution on n_o and s_o. That is,

$$v_o = \bar{s}_o \cdot n_o$$

For the purpose of the Draft Environmental Impact Statement for lease sale #48, the U.S. Geological Survey has calculated a distribution on the number of major spills which takes into account the magnitude of the crude expected from lease sale #48 tracts. This distribution is shown in Figure II.D.8, along with the distribution on v_o implied by the formula above. Note that the expected number of major production, handling, and transportation spills over the productive lifetime of lease sale #48 tracts is just over five and that the expected total volume of major oil spills is 207 Mbbl (just under the 1 day peak production rate).

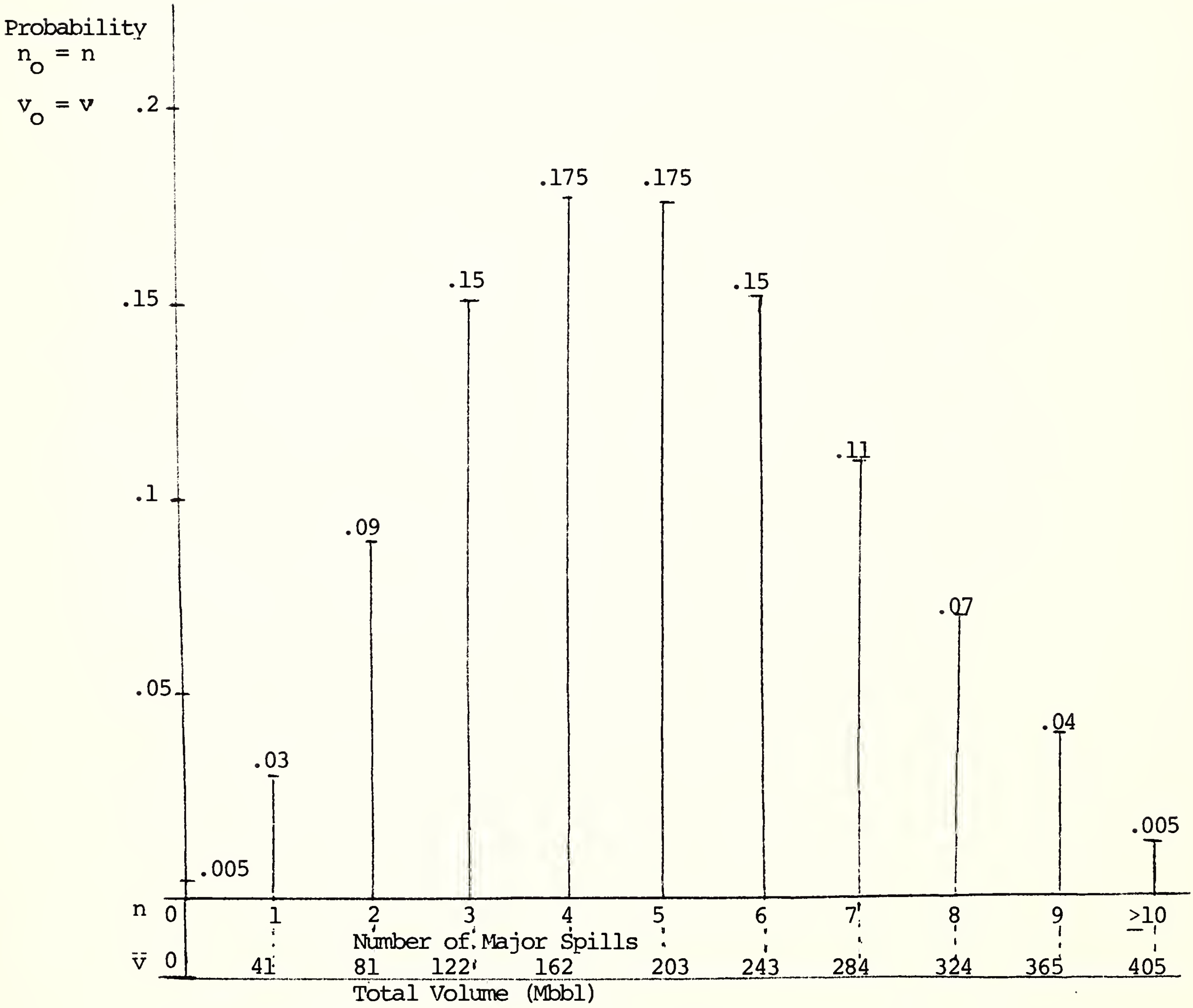
---

[19] Two possible modifications have opposing effects. That is, it might be argued that spills sizes would be consistently higher in frontier locations such as the Outer Banks area, as that spill sizes will be lower due to production, handling, and transportation improvements. Timothy Wyant and James R. Slack, op. cit., p.3.

[20] OCS Oil and Gas: An Environmental Assessment, Council on Environmental Quality, 1974.

Figure II.D.8

Probability Distributions on the Number and Total Volume of Major Oil Spills Resulting From Lease Sale #48.



Expected Values: $\bar{n}_o = 5.1$ Medians: $n_o^* = 4$

$\bar{v}_o = 207$ $v_o^* = 162$

Sources: (derived from)

1. Draft Environmental Impact Statement: Lease Sale #48, U.S. Department of the Interior, June 1978.
2. OCS Oil and Gas: An Environmental Assessment, Council on Environmental Quality, 1974.

iii. The Cost of Oil Spills

Spilled oil causes damage when chemicals produced by reactions or originally within the crude contact things of value. The amount of damage depends not only on the sensitivity of the valued object, but also on the amount of spilled oil, the chemical composition of the spilled hydrocarbons, local weather conditions, the relative locations of the spill and the valued object, the time of year, and the nature of any clean-up operations [21]. Given the enormous variety of valued objects with some potential of contacting spilled oil, and the enormous uncertainty associated with each of the factors and implied relationships cited above, it is clear that a truly accurate list of damages from spilled oil would be extremely difficult to construct. Furthermore, such a list would ultimately need to be reduced to dollar quantities in order that comparisons with other effects were possible.

The scientific problems associated with this direct route are avoided herein by assuming that damages due to lease sale #48 major oil spills will be in proportion to damages suffered as a result of the blowout at Union platform A in the Santa Barbara Channel on January 28, 1969. This spill is estimated to have amounted to 77,000 bbls over the first 100 days [22]. We believe that this procedure overestimates by a considerable amount the actual damages that will occur since the Santa Barbara spill was relatively nearer to shore, larger, and of longer duration than the average lease sale #48 spill. Nevertheless, we would rather overstate than understate damages in such a sensitive area.

---

[21] Ca. OPR, op. cit. pp 416-418.

[22] Ibid, p. 420.

The cost of a major oil spill can be separated into two components: effects capable of being valued by the market or the courts, and effects not valued by the market or court.

Most but not all biological effects fall into the latter category. That is, biological damage to the productivity of shellfish beds and fisheries is at least in principle capable of being valued by the market or courts. However, it does not seem currently within the knowledge of ecologists to be able to determine whether one ecological state is better or worse than a previous state. In the absence of valid ecological objectives, evaluation attempts generally concentrate on whether changes in the environment bring about a new long term ecological state. The implicit objective is the purely conservative one of minimizing change - of leaving well enough alone. If this objective could be realized independently of other social objectives, then it would seem plausible given uncertainty and a justifiable attitude of risk aversion. But clearly, real actions have effects which advance and retard a variety of objectives - and the choice of a best action requires the balancing of all these objectives.

Because we cannot concur with a lexicographic ordering of actions based on minimizing ecological change, because ecologists have not yet been able to value alternative ecological states in a manner which is compatible with other social objectives, and because even the long-term biological effects of oil spills are the subject of scientific dispute [23], we have chosen to exclude such effects from explicit evaluation [24]. We assume that individuals concerned with these effects will continue to ensure that society also values them by exercising their influence in the political arena.

---

[23] "The biological effects of spilled oil are the subject of considerable controversy, with a literature that is voluminous, often equivocal, and occasionally contradictory. Essential issues are hotly disputed, and general concensus does not exist among scientists who have conducted research on the subject." Ibid, p. 415.

Remaining then are market valued effects, and external effects amenable to economic evaluation. Compensation for damages in the latter class if made, is generally accomplished via the legal system. Analysts for the Department of Interior have estimated that the total economic cost of the Santa Barbara blowout amounted to $16,000,000 [25]. This total presumably includes the value of lost crude, cleanup costs [26], unrecovered external damages, and recovered damages (4.5 million dollars were awarded beachfront property and boat owners). For the purpose of a crude estimate, we use this figure (expressed in 1978 dollars) along with the 77 mbbl estimate of the amount of crude spilled to obtain a cost of $344/bbl spilled.

---

[24] "Scientists of the Allan Hancock Foundation of the University of Southern California conducted the major study [of the 1969 Santa Barbara Channel blowout] which was terminated in June of 1970. Barnacles, surf grass, and algae suffered significant damage, mainly from smothering by the crude oil. Thousands of sea birds were killed. With these exceptions the scientists were unable to demonstrate large scale damage to organisms in the study area. Recolonization of the cited intertidal areas began within the year." *Ibid*, p.420.

[25] W.J. Mead and P.E. Sorenson, "Estimate of the Cost of the Santa Barbara Oil Spill of 1969" *Draft Environmental Statement, Oil and Gas Development in the Santa Barbara Channel Outer Continental Shelf Off California*, III, Department of the Interior, pp. 183-185.

[26] Argonne estimates the cleanup cost at $40-120/bbl which translates to $55-$165/bbl in 1978 dollars.

This figure, along with the distribution on the total volume of major oil spills during the course of lease sale #48, implies a distribution on the cost of oil spilled. Also, by multiplying the cost per barrel spilled noted above by the expected total spill volume and dividing by total production, one arrives at a crude estimate of the cost of oil spills per barrel produced of $0.100/bbl. This figure may be compared with similar figures for air pollution costs presented in the previous section. The expected total cost of oil spills from lease sale #48 operations as a function of discount rates was given in the summary of this section.

4. Other Effects

Two other classes of effects apparently of concern to state and local officials are the increased risk of vessel collisions due to higher traffic densities and the local economic ripple effects associated with lease sale #48 production activities. Although neither of these effects have been analyzed for the purpose of this demonstration, they should be considered in a more complete impact analysis.

Direct damages (injuries to the crew, damages to vessels and cargo) resulting from vessel collisons will generally be absorbed by the responsible parties, and will not affect the local population. Nevertheless, these damages do have the effect of increasing the cost of production and thus decrease the lease sale #48 direct economic social surplus calculated in section C. (Note however that costs associated with oil spills have already been considered in the previous section.)

From a local perspective, the key aspect of the vessel collison issue would seem to be that it calls into question the distribution on the number and size of oil spills presented earlier. Has the increased traffic density been adequately considered by the Geological Survey in the preparation of these distributions? If yes, then vessel collisions should not be an additional major concern of state and local officials - if no, then the already high costs of oil spills have been underestimated.

Local economic ripple effects include increases in regional income, tax collections, demand for public services, demand for general goods and services, and price levels. It is widely recognized that these effects are negative only when the surrounding economy is not compatible with oil and gas production activities (e.g., non-industrialized). Inasmuch as the southern California area is highly developed and has a long history of petroleum production and transportation activities, it is reasonable to assume that local economic ripple effects will be of negligible relative magnitude (and probably positive since air quality and oil spill damages have already been considered.)

The local economic effects of lease sale #48 may be compared with published estimates of these effects for lease sale #35. This is because lease sale #48 can be viewed as a second phase of lease sale #35, which when held several years ago, resulted in fewer sales than expected (56 of 297 tracts offered were actually leased). That is, if the current sale is robust, then the aggregate of the two will approximate the level of activity anticipated prior to lease sale #35. The California Office of Planning and Research reports that:

> The development of Outer Continental Shelf oil and gas off the coast of southern California will not substantially alter the structural relationsips or the overall volume of economic activities in the affected onshore communities. [27].
>
> The impacts of lease sale #35 will be felt primarily in he adjacent counties of Ventura, Los Angeles, and Orange. These impacts will be so small that direct and indirect employment will be insignificant, with imperceptible increases in public service demand. These conclusions would hold true even if the level of new OCS activity were three times that currently anticipated.
>
> In Los Angeles and Orange counties, short term price increases for housing and consumer durables will be inconsequential. Price increases may approach 2% in Ventura.
>
> New facilities inspired by lease sale #35 will constitute only a small fraction of the total assessed valuation of each of the affected counties ..... However, any municipality which is the site for one or more of the facilities may realize a substantial tax windfall which exceeds new service demands. [28].

---

[27] OPR, op. cit., p. 485.

[28] Ibid., p. 61-62.

Part two.
Case studies.

James L. Berger.
Charles N. Hoffeditz.
Bruce W. Norman.

Preface.

This part contains three case studies that are focused on major controversies over the siting of energy facilities in the coastal zone. These three controversies have been selected for detailed examination because their outcomes are certain to have a national impact both on the supply of energy and in setting precedents for coastal management.

A major conclusion of this Study is that there can be no algorithm for determining the national interest which can be applied uniformly to specific decisions regarding the location of coastal energy projects. Rather, there are many competing national objectives (and factions associated with each) which inevitably clash during the decision process (e.g. scenic preservation, beach access, water and air quality, economic growth, full employment, adequate energy supply, reduced dependence on foreign oil, strength of the dollar in international monetary markets, etc.).

How can this clash of objectives be resolved? How can "the national interest" be found amidst the cacophony of intense voices from governmental authorities, private interests, and organized citizens? Not easily! But despite the difficulties, a continuing effective means of resolution must be found if the nation's goals for environmental quality, social justice, and economic progress are to be achieved. The implementation of the 1976 amendments to the Coastal Zone Management Act must contend with these conflicting national objectives if it is to become an administrative reality as well as an inspiring statement of a national ideal.

The three case studies in this volume are: (1) the SOHIO Terminal and Pipeline at the port of Long Beach, California for the transshipment of Alaskan crude oil through an underutilized natural gas pipeline for distribution to the East and Midwest from Midland, Texas; (2) the off-shore development of oil and gas in the scenically beautiful Santa

Barbara Channel of California by Exxon Corporation at a site known as the Santa Ynez Unit; and (3) the transshipment by tanker of Alaskan crude oil through Washington's Puget Sound and then by pipeline to supply crude oil to the mountain states in the mid-west.

All of these case studies are, of course, located on the Pacific Coast which has become a principal site for the development of newly explored off-shore and gas reserves and has, obviously, become a principal focus for the transshipment of Alaskan crude oil once it began to flow in July 1977.

No attempt has been made to achieve a balance between the various regions of the nations in selecting these case studies. Rather, the focus on the three Pacific Coast cases was explicitly chosen because of the intensity of the controversies, their topical and critical nature, and the precedents likely to be established through their resolution. More important, these cases involved local areas which could meet their own oil and gas requirements without the proposed energy facilities. Understandably, the affected localities are reluctant to absorb the additional burdens to their environments and economies for the benefit of inland areas whose energy supplies are in jeopardy. Thus, the case studies in this volume have been chosen because they can illustrate the difficulties involved in providing adequate consideration of the national interest in the net national benefits sense. The premise of the case studies is that by carefully examining the complex details of several very intense controversies, a better understanding of the requirements of implementing the "national interest" provision of the CZMA can be gained and the utility of analysis and its implementation better defined.

These case studies were prepared by mid-career professionals from NOAA who were assigned to the Center for one year. The SOHIO study was prepared by Bruce W. Norman, who is currently with the National Marine Fisheries Service. Jeffrey D. Roughgarden assisted with the final drafts of the SOHIO study. James L. Berger, author of the southern California OCS study, is currently with the Office of Oceanic and Atmospheric Services. Charles N. Hoffeditz, author of the Pacific North-West study, is currently on temporary assignment with the Office of Coastal Zone Management.

Prior to their coming to the Center, none of these NOAA professionals had received any formal training in policy analysis or technology assessment. All, however, had been exposed to the demands of policy formulation and assessment in their various resource management responsibilities within NOAA. The purpose of their assignment to the Center was to receive special and intensive training in the techniques and applications of analysis of resource management policy issues of special relevance to NOAA. The mid-career professionals worked with Departmental faculty and senior graduate students, learning the techniques of analysis, and preparing to return to NOAA to apply the structure of analysis being developed to assist in the implementation of the "national interest" provision of the CZMA.

Their work on these case studies represents their own personal synthesis of training and application in the techniques of policy analysis as related to coastal management questions. The need for greater professional capabilities in addressing policy questions raised by demands on the nation's coast and other resources under NOAA's management jurisdiction is abundantly apparent by the complexity and intensity of the controversies presented in the following.

John T. McAlister, Jr.
February 1, 1979.

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The SOHIO Oil Terminal and Pipeline Controversy

by

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I. THE SOHIO OIL TERMINAL AND PIPELINE CONTROVERSY

A. Introduction and Summary

In December of 1975, the Standard Oil Company of Ohio (SOHIO) announced the selection of the Port of Long Beach as the site for a crude oil terminal and beginning point for a pipeline to carry Alaskan North Slope crude to markets in the midwestern and eastern United States. That selection has both a history of controversy preceding it and a continuing controversy emanating from it. The purpose of this case study is to explicate the particulars of the current controversy and to locate that controversy in the larger matrix of national oil supply.

The controversy over the SOHIO project is attractive as the subject for a case study for two reasons:

- The controversy arises out of a natural bargaining process in which the rules are being made up as the game is played. The process may set precedents for future siting decisions and may provide raw material for assessing bargaining itself as a paradigm for such decisions.
- The notion of the national interest was a pervasive element in the controversy -- its presence was felt, but its nature was obscure. Since the Coastal Zone Management Act requires the states to "consider the national interest" in coastal energy facility siting decisions, the controversy provides evidence of the natural use of the term.

In other parts of this Study, recommendations are made to structure the bargaining process so as to capitalize on its inherent virtues. Also, a concept of the national interest is rigorously derived to render its invocation less ambiguous and rhetorical. The SOHIO controversy is, therefore, a natural laboratory in which to observe the concepts in vivo and by which to inform the attempt to make them more workable.

The case study seeks to do three things in fulfilling its purpose:

- to tell the story of the controversy from its origins on the North Slope, through the realization of the so-called West Coast Oil Glut, to the particular problems raised in the siting issue proper;
- to illuminate the decisions which preconditioned the existence of the SOHIO proposal, the economic conditions which provide the impetus for it, and the logic of the participants in the controversy;
- to comment on the role of the national interest and on the bargaining process in the controversy.

The basic perspective is political. That is, the study is explicitly conscious of the stakes for each participant and the interactions among participants to affect the ultimate decision. No attempt is made to examine in detail the technical data accumulated on the project (as was done for the demonstration analysis on lease sale #48) -- the focus is on the logic behind the data as a reflection of the strategies in the bargaining process. The intent is not to second guess the decision, but to critique the decision process for the benefit of analysts who seek to improve the process and administrators seeking to understand the usage of the term "national interest."

SOHIO proposed to construct a marine oil terminal at Long Beach to connect with an underutilized gas pipeline from Midland, Texas in order to reduce the cost of transporting its North Slope crude to the East and Midwest relative to its next best alternative - the Panama Canal route. The expected cost reduction (estimated in excess of $100 million annually) represents a benefit to the nation primarily in the form of increased profits to SOHIO. These profits would be distributed to the federal governments as taxes and to shareholders as dividends, or used for increased capital investment which could result in more efficient energy supply and in capital gains for shareholders.

From an economic perspective, the SOHIO proposal represented a declaration of intent on SOHIO's part to commit a large part of its resources and simultaneously a request to public officials to permit the possibility of some degradation of the environment. The current federal and state environmental regulatory regime has the effect of making public officials sole proprietors of several resources necessary for economic activity (e.g., air, water, and land use permits). Given this structure and the impetus provided by the tradeoff provision of the Clean Air Act, bargaining arose very naturally between SOHIO and the State of California, represented by Tom Quinn, Chairman of the Air Resources Board and Special Assistant to the Governor for Environmental Affairs.

The bargaining process eventually resulted in modifications to the original proposal that were in the interests of all parties. Nevertheless, there were many faults with the process, and hence much room for improvement. In particular:

- No level of government ever developed the comprehensive and balanced view of the proposal necessary for a true determination of interests. Fortunately, little damage arose from this because the issues seemed to boil down to SOHIO's profits versus southern California's air quality. Each concern had its own champion - there was little need for balancing or coordination within each champion's camp. However, the nature, magnitude, and distribution of energy facility effects is not always so well-suited to current government organization.
- The process was protracted and vitriolic. The antagonism resulted in large part from the failure of both

parties to acknowledge the other's authorities and objectives as legitimate. Apart from ill will, the delay was due to the myriad of separate permits required and considered without coordination, and more importantly, to the precedent-setting nature of the the bargaining process. The delay was costly to all parties - to the nation and SOHIO because it continues to use the more expensive Canal route and to southern California because subsequent studies showed that the SOHIO project would result in marginal air quality improvement, even as originally proposed.

- Questions of equity arose during the course of Quinn's very effective negotiations. While it is commonly acknowledged that injured parties have the right to recover damages, the last point above shows that the SOHIO negotiations were of a different hue. Figuratively speaking, Quinn was a spatial monopolist selling air quality permits. Accordingly, he could charge as high a price as the market would bear given the lack of specificity of the trade-off provision. Quinn ultimately extracted about $80 million worth of offsets from SOHIO - a generous settlement on Quinn's part given the discounted value of cost savings over the Canal route.
- Although the existence of net national benefits was generally acknowledged, the federal government, as the proponent for the welfare of the aggregate, failed to contribute constructively to the resolution of conflict arising from the distribution of effects. Both the Executive and Congress seemed to believe that California and Long Beach were morally obliged to accept a less than fair share of the national benefits. Arising from an incorrect concept of the

national interest (combined perhaps with a naive hope that all these things balance out in the long run), federal actions ranged from bland statements on the public welfare to Congressional threats of pre-empting state authorities.

The SOHIO case study which follows illustrates both the promise and the pitfalls of bargaining as a mode of energy facility siting conflict resolution. Bargaining offers the promise of an economically efficient outcome, but the fairness of that outcome depends critically on the initial positions of the agents. Bargaining promises a solution which is acceptable to all parties, and which is not imposed coercively by an external entity, but the process can be lengthy and heated unless special care is taken.

This Study argues that an institutionalization of cooperative analysis and bargaining between developers and whole levels of government constitutes the remedy to the nation's crisis with facility siting decision-making. As shown in this case study, these recommendations are not radical - rather they represent an improvement and formalization of informal processes which arise naturally. The real question is whether Congress and the Executive are willing to make the investment of time needed to deal with so general and comprehensive a problem, whether they prefer to continue "fire-fighting" - resolving an endless sequence of siting controversies coercively by statute, or whether they would just rather ignore the whole issue. In the interim, developers like SOHIO, regions like southern California, and the consumers of the nation suffer the effects of inadequate public decision processes.

B. A Review of the Controversy

The purpose of this section is to set the stage for the substantive and procedural discussions which follow. The section begins with a brief review of the factors which contribute to the existence of the current West Coast crude oil (and residual products) glut, which in combination with current federal policy precluding the export of Alaskan crude to Canada or Japan, led SOHIO to propose its terminal and pipeline project. Next, the specifics of SOHIO's original proposal are presented and the evolution of the proposal as a result of bargaining is traced. (Although some updating has been possible during editing, primary research on this case study ended in September 1978, and consequently the record is complete only up to this date.) The final portion of this section contains a list of the principal agents concerned with the SOHIO proposal and brief summaries of their announced interests.

Unlike other owners of North Slope crude, SOHIO has no appreciable refining or marketing facilities on the West Coast capable of receiving its 53% share of the Trans-Alaskan pipeline flow. SOHIO is unable to sell its share to existing West Coast refineries because West Coast demand for crude like the North Slope variety is far less than its available supply. The over supply situation arises from the continuing need to import sweet, light Indonesian crude (for blending purposes to meet air quality standards) and from the political necessity of maintaining some outlet for indigenous California crude.

These facts, along with the questionable current federal policy of precluding "crude oil swaps" with Canada or Japan, forced SOHIO to seek ways of transporting its crude from the North Slope to its refineries in the Midwest and East. The search for a least cost transportation alternative led SOHIO in December 1975 to propose, as an alternative to the current Panama Canal route, the construction of a marine oil terminal at the Port of Long Beach and the conversion of an underutilized east-to-west natural gas pipeline for west-to-east crude transport. Initially, from both an environmental and economic point of view, the proposal seemed advantageous.

However, in March 1976, Tom Quinn, Chairman of the California Air Resources Board (ARB) and Special Assistant to the Governor for Environmental Affairs raised three objections to the project. Quinn was particularly concerned over the contribution that tanker fuel combustion products, loading and storage emissions, and pipeline pumping emissions would have toward increasing the frequency and severity of air quality standard violations. Secondly, he was concerned that conversion of the gas pipeline would lead to reduced supplies of natural gas in southern California - the preferred fuel from an air quality standpoint. Finally in his capacity as environmental advisor, he was concerned that increased vessel traffic would increase the likelihood of major oil spills. But these last two issues took a backseat to direct air quality concerns.

The existence of the trade-off policy within the Clean Air Act provided the impetus for intensive bargaining between representatives of SOHIO and the ARB. Put simply, the trade-off policy requires that new developments in areas which significantly violate standards are to be permitted only when the development promises demonstrable air quality benefits. These benefits are to be realized via the offset policy whereby the developer agrees to reduce pollution levels of other sources (already complying with regulations) by an amount in excess of the contribution of his project. While this concept is straight-forward in theory, it proved complex in practice. Negotiations were bitter regarding such issues as the definition of which elements of the system were subject to the offset procedure, what level of operation was appropriate for the base case calculation, and what offset ratio was appropriate.

Eventually, a tentative agreement was reached whereby

SOHIO agreed to install pollution abatement equipment on a Southern California Edison power plant and several dry-cleaning establishments at a cost estimated in excess of $80 million. This figure approximates the annual savings in transportation costs of the SOHIO pipeline over the Panama Canal route. With SOHIO's capitulation, state regulators generally agreed that the proposal, as modified by bargaining, was in the region's interest and would result in net air quality benefits. A recent referendum in the cityof Long Beach was also favorable toward the modified proposal.

A summary like this tends to imply that the decision process was logical, orderly, and relatively trouble-free. The following subsections will quickly dispell such an impression.

1. North Slope Crude and the West Coast Residual Glut

In 1968, several oil-bearing formations were discovered at Prudhoe Bay on Alaska's North Slope. Shortly thereafter, (1970) domestic production peaked. Since energy demand continued to rise while domestic production leveled off, the United States became increasingly dependent upon imported crude to meet demand. At the time of the Arab oil embargo (October 1973) imports were 36% of consumption and the world delivered price was around $3 per barrel. In 1977, imports had increased to 47% and the cartel price had escalated to around $14.00 per barrel. The embargo and subsequent cartel pricing actions were cause for anxiety in two respects: first, the insecurity of oil supply was dramatized, and second, the United States balance of payments began a slow but persistent tilt to the deficit side.

The Federal Government's response was to seek by various means to achieve long term energy independence, a policy announced in 1974. Important to that policy was the development of the Alaskan North Slope. The expected recoverable oil from known North Slope fields has been estimated at 9.6 billion barrels, the significance of which is evident when compared with the nation's oil consumption in 1976 of about 5 billion barrels.

To make the newly discovered North Slope crude available to the oil-hungry "lower 48" a pipeline was proposed in 1969. Construction was delayed by the route selection process and controversy over the associated environmental impacts. This siting controversy was resolved in November of 1973 (one month following the onset of the Arab embargo) by Federal legislation authorizing the Trans-Alaska Pipeline System (TAPS) and pre-empting further environmental challenges.

Some 53% of the North Slope oil is owned by the Standard Oil Company of Ohio (SOHIO) and its partner (now parent), British Petroleum (BP). [1] The other principal owners of North Slope crude are the Atlantic Richfield Company (ARCO) and Exxon (each owning 20%) which do have refining capacity on the West Coast.

Prior to its involvement in Alaska, SOHIO was a minor midwestern oil company, dependent upon foreign supplies and with no facilities on the West Coast. The financial backing of BP made it possible for SOHIO to catapult itself into the big leagues with respect to crude oil ownership, but it still lacked West Coast facilities. As the cards lay, SOHIO had to

- sell its crude (estimated at 700,000 B/D at initial operational TAPS capacity) to refineries on the West Coast,
- sell the crude to Japan and Canada, or
- transport its oil for distribution to its facilities in the Midwest and East.

The remainder of this section is devoted to an explanation of the causes of the current West Coast residual glut, the existence of which led SOHIO to reject the first alternative.

In 1973, it was officially expected that West Coast demand would absorb North Slope production, particularly due to fuel oil substitution as natural gas became scarce. Perhaps lost in the TAPS controversy and the euphoria over the new discovery were certain physical realities of North Slope crude quality and ownership, and West Coast refining capacity, which would affect that region's ability to absorb the new influx of crude.

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[1] National Energy Transportation, Report prepared by the Congressional Research Service for the Chairmen of the Senate Committees on Energy and Natural Resources, and on Commerce, Science, and Transportation, Volume III - Issues and Problems, March 1978, p. 276.

Higher prices and limited conservation measures significantly reduced the rate of increase in demand (especially for gasoline) on the West Coast. In addition, the absorptive capacity was not there to begin with. The TAPS was designed to carry 1.2 million barrels per day (MMB/D) initially, with relatively easy adjustments to 1.6 MMB/D, and could ultimately transport 2 MMB/D. The FEA estimated West Coast maximum capacity to absorb North Slope oil at 800,000 B/D by July 1978. [2] By mid-1978, TAPS throughput reached 1.1 MMB/D. A long-term crude oil surplus in this region became apparent.

Physical refinery capacity in California (an estimated 2.3 MMB/D in 1976 [3]) is more than comparable to the volume of North Slope production, but sheer capacity is only part of the story. Crude oil is not everywhere (or even locally) uniform in its physical characteristics, particularly sulphur content and specific gravity. Refineries are built to maximize the refined value of input crude within some design range of characteristics. High sulphur crude means a higher residual sulphur content in the refined product and greater stress on the facility. Heavy crude yields smaller quantities of high value products (gasoline, jet fuel) and large quantities of lower value residuals (fuel oil, asphalt). Low sulphur, light crude is a rarity and commands a higher price. Therefore, crudes are blended to create an optimum feedstock for a given refinery. North Slope crude does not fit neatly into the design range for feedstock of most existing West Coast refineries and must be blended to be used optimally. Thus, there is a continuing need for high quality foreign imports for blending.

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[2] President's April 15, 1977 Report to Congress on the Pricing of Alaska North Slope (ANS) Crude Oil, Federal Energy Administration, p.6.

[3] "The Effects of Southern California Outer Continental Shelf Development Upon the California Refining and Petrochemical Industries", Gerald L. Sauer, in The Impact on California's Coastal Zone from Proposed Offshore Oil and Gas Development, edited by John T, McAlister, Jr, William K. Linvill, and Harry D. Saunders, Center for Technology Assessment, Department of Engineering-Economic Systems, Stanford University, July 1975. p. 171.

North Slope crude is most comparable to Iranian and Saudi Arabian crudes -- a little lower in sulphur, but heavier. It is of considerably higher quality than heavy sour California crudes and considerably lower quality than sweet, light Indonesian crude. In terms of quality, North Slope crude competes directly with Persian Gulf crudes and dominates California crude. Thus, for 800,000 B/D of North Slope product to remain on the West Coast, it would have to displace all imports other than Indonesian (521,000 B/D in 1975), and much of the locally produced crude (279,000 B/D or roughly 1/3 of California's production). But displacement is improbable for a number of reasons: politically, since California producers would certainly object economically, since California crude has some price advantage over North Slope crude; and operationally, given long term contracts for crude supply. The point is that either substantially less than 800,000 B/D of North Slope crude will be absorbed on the West Coast in the near term or California producers are going to be hurt.

In addition to the normal operational need for Indonesian crude, current residual sulphur standards make this fine crude even more valuable. To be used by southern California utilities for electricity generation, fuel oil currently must be .25% or lower in sulphur content. North Slope crude averages around 1% and Indonesian crude averages around .07%. While refiners do not gear their operations to produce fuel oil, Indonesian crude is the only major blending stock capable of yielding residual products within this standard. Fuel oil above this standard must be sold for bunker fuel (used to power ocean vessels), an even less valuable product. Current refining operations do produce substantial amounts of bunker fuel. To produce less would require a higher proportion of expensive Indonesian crude or expensive reprocessing of residuals. The result is that, in addition to more crude being available on the West Coast than can be absorbed, there is a glut of bunker fuel which is uneconomic to store, which cannot be exported as a matter of federal policy, and which is uneconomic to transport to other U.S. markets.

The low sulphur standard may make North Slope crude more attractive since less of the expensive imported crude is needed to dilute sulphur. This factor may offset the price advantage of California crude (which can be higher than 5% sulphur) and certainly gives North Slope crude an advantage over higher priced higher sulphur Persian Gulf crudes - if there is a market for residual products. There is evidence that displacement is occurring on both fronts: California foreign imports dropped about 216,000 B/D between 1975 and 1978 and there are indications that some contracts for local crude have been cancelled. [4]

The market for North Slope crude could be improved by changes in the physical plant among West Coast refiners. New refineries, conversion of existing plants to accommodate North Slope oil, and desulphurization equipment would enhance the capacity of the West Coast to absorb available North Slope crude. These changes are all expensive and are slow to be made for two weighty reasons. First, production of refined products is driven by the demand for higher value products, especially gasoline. The demand for gasoline was slowed by the Arab embargo and has not caught up to the increase in supply of crude. New refineries and conversion of existing plants will not occur until adequate demand exists. Desulphurization equipment would increase the amount of usable fuel oil in southern California, but currently plentiful natural gas is preferred -- again, the demand is not there (at least not in short term).

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[4] The Department of Energy has proposed changes to regulations which may allow for some product exports and give California producers a larger price advantage. The drop in California imports is calculated form data supplied by phone from the Calfironia Energy Resources Conservation and Development Commission and from the latter's 1977 biannual report, California Energy Trends and Choices, May 1977, vol. 4, p. 263. Indications of contract cancellation were reported in the Los Angeles Times, August 28, 1977, Sec.8, p.1, col.5. The magazine quoted an estimate of at least 100,000 B/D of Califronia crude being shut in. (May 15, 1978,p.78).

Demand elsewhere in the United States does suggest the building of new pipelines, but this brings up the second reason changes in physical plant are slow: uncertainty over government regulatory activities. All the above capital changes are likely to require permits which are becoming increasingly onerous to obtain. In addition to being slow, difficult and expensive, the ground rules are subject to change which may obviate whatever investment was made [5]. Altogether, the environment breeds caution in investment decision-making.

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[5] Standard Oil Company of California invested in new capacity and desulphurization equipment in 1976 only to have sulphur standards halved in 1977. Certainly, the controversy to be examined in this case study is an example of the difficulty of major capital investments by the oil industry.

Lodwrick M. Cook, Vice President of ARCO, has stated:

> [W]e find ourselves in an environment where it is increasingly difficult to plan and construct energy related facilities. This is because there [is] no adequate mechanism for timely resolution of the conflicts between two national goals [:] environmental protection and energy resource development.
>
> Due to this situation, timely construction of any major new transportation system to move surplus west coast crude oil to the rest of the nation may require enactment of enabling legislation similar to that which made possible the construction of the trans-Alaska pipeline.

Joint Hearings, Part II, December 7, 1976, p. 140.

The discussion thus far has focused on the near-term impact of North Slope oil on the West Coast supply situation. A third aspect of the West Coast surplus (in addition to sheer volumes of North Slope crude available and the glut of residuals) is the future potential from the Elk Hills Naval Reserve and development of the California OCS. The supply implications of OCS development are dealt with in another case study. Elk Hills was ordered into production by Congress in April 1976 (Naval Petroleum Reserves Production Act of 1976, P.L. 94-258). The order required the Navy to have a transportation system in place and to be producing 350,000B/D by April 1979. In the context of the manifest local surplus situation and problems with the preferred transportation system, Elk Hills production has been shut back in. The surplus is expected to last well into the 1980's without Elk Hills or the OCS. The latter two resources, particularly Elk Hills, while not at the moment contributing driving force, form part of the background to the West Coast supply situation and the history of SOHIO's problems.

In summary, the existence and continuation of the West Coast oil surplus can be attributed to several factors: [6]

- North Slope crude oil flow effectively reaching the first operational plateau at 1.1 MMB/D.
- Physical and operational limitations on West Coast refining capacity.
- A continuing need for low sulphur crude from foreign sources.
- Market constraints, including prohibitions against export, on residual products.
- Uncertainty over governmental regulatory activity (pricing, permitting, standards).
- Future potential from Elk Hills and the California OCS.

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[6] Adapted from California Energy Trends and Choices, op.cit. p. 255.

2. SOHIO's Original Proposal and the Initial Response

As the excess supply of crude oil relative to the West Coast demand became apparent in 1974, SOHIO began to look for a lower cost alternative to using the Panama Canal to move its oil to other markets. By December 1975, it had selected the Port of Long Beach as the site for an oil terminal and starting point for a crude oil pipeline to Midland, Texas, a nexus of distribution to the Midwest and East. The location was particularly attractive because of the promixity of an underutilized east-to-west natural gas pipeline system which could be converted for reversed flow of crude oil, saving an estimated $500 million in pipeline construction costs.

Several other factors seemed to make the site ideal. The adverse aesthetic and operations impacts of an oil terminal would be strictly marginal to the highly developed port and its surroundings. The terminal itself would simply be added within the existing infrastructure (harbor breakwater, power supplies, pipeline rights of way, etc.). The area had a large labor and industrial base to facilitate construction and operation. The particular location within the harbor would minimize maneuverability and traffic problems and would require minimum dredging to accommodate large tankers. In addition, a second gas pipeline existed which might be likewise converted to double the initial capacity of the project. The only permit singled out for mention when the project was announced was the dredging permit from the Corps of Engineers.

Specifically, SOHIO proposed a three-berth terminal to accommodate vessels up to 165,000 DWT delivering an estimated 700,000 B/D of North Slope crude. Of this quantity, 500,000 B/D would enter the pipeline and 200,000 B/D would be sold locally. The terminal would be in the outer harbor, consisting of berths, a breakwater shielding the berths, a pipeline trestle connecting the berths with six storage tanks, and control facilities constructed on the pier. Two additional storage tanks would be located several miles inland in the Dominguez Hills industrial area and connected to the terminal with a pipeline. From there, pipelines would be built to link up a short natural gas pipeline owned by Southern California Gas Company, the longer El Paso Natural Gas Company pipeline, and an eastern terminus at Midland. Along the way, pumping stations would have to be constructed or replaced to reverse the flow and to accommodate crude oil. The whole pipeline would be 1026 miles long, of which some 790 miles would be converted gas pipeline.

The entire system would be monitored electronically, involving a microwave communications system and several control computers. The terminal would be a modern facility with oil spill containment booms, fire control and oil spill clean-up equipment. The pier landfill would be compacted and the tanks surrounded with dikes capable of holding 125% of their capacity. Facilities would also be provided for public access to the water side of the pier and for viewing terminal and harbor operations. SOHIO originally estimated the total cost of the project at $500,000, the terminal itself being built by the Port as a common carrier and leased to SOHIO as operator.

Altogether, the whole project has been estimated at one time or another to require from 700 to 847 permits. Whatever number is accurate, [7] either has graphic power, even though all but a few permits are routine. From an economic point of view, a time-to-operation point of view, and an environmental point of view, the proposal seemed optimal. SOHIO set itself an ambitious timetable of four years to operation. [8].

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[7] SOHIO considers the source and number of permits to be proprietary information. The estimates cited appeared in various reports by the Los Angeles Times: 700 appeared in several early articles, 847 appeared June 25, 1978 (Sec. 1, p.3, col. 1), and 715 was used August 18, 1978 (Sec.1, p. 3, col. 2).

What SOHIO failed to take adequately into account was the federal Clean Air Act and California clean air laws. Air quality aside, SOHIO had pretty well designed and sited around potential issues important to most major permitting authorities. But putting air quality aside was just what concerned Tom Quinn, Chairman of the California Air Resources Board (ARB) and Special Assistant to the Governor for Environmental Affairs. To arbitrarily date the beginning of the controversy, Quinn, Richard Maullin (Chairman of the Energy Commission), and Leonard Ross (Member of the Public Utilities Commission), published a piece in the Los Angeles Times opinion section on March 21, 1976, stating:

> One consideration, however, has been left out of these plans: air pollution ... evaporative emissions from .. storage tanks, together with emissions from the tanker unloading process, could add up to 9,000 tons of hydrocarbons per year to the atmosphere - a burden equivalent to the exhaust emissions of the approximately 900,000 automobiles meeting 1976 standards.
>
> Even more serious, some of the proposed methods for transporting the Alaskan oil could interfere with the flow of natural gas to Southern California ...
>
> ... Southern California's smog problem is being greatly aggravated by the conversion of electric generating facilities from natural gas to fuel oil.

As the second paragraph indicates, the brunt of these remarks was aimed at Federal authorities, especially the Federal Energy Administration (FEA), headed at that time by

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[8] Estimates when the project was announced were at least one year to gain approval and three years to construct. As the controversy has developed, these estimates are reversing.

Frank Zarb who had policy authority over natural gas curtailments. [9]. But the SOHIO project was clearly the occasion. The issue is air quality, both as it is directly affected by the oil terminal and indirectly and potentially affected by the preemption of the natural gas lines.

Natural gas is the preferred fuel for electricity generation in California, but deliveries from the Southwest were declining both because of declining interstate supplies and higher priority needs in the Northeast. [10]. This situation could change in the future for two reasons: deregulation, which might increase interstate supplies; and selection of an

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[9] While natural gas is not allocated per se, the Federal Power Commission (now the Federal Energy Resources Commission) could "curtail" shipments to one region in favor of another to maintain priority uses. The FPC/FERC is semi-independent of line agency authority, but Zarb at the time was energy advisor to the President and could exercise policy authority over the Commission.

[10] Southern California deliveries by El Paso Natural Gas Company had declined from 95.6% to 92.1% of contract quantities from 1973 through 1975 and overall southern California deliveries were projected to continue to decline at 5.5% per year through 1985. By 1980, the lowest three (of five) priority categories would be cut off; by 1985 only the first priority would be substantially met. The data is contained in "10-Year Forecast of Gas Utilities" Requirements and Supplies 1976 - 1985," Staff Report to the California Public Utilities Commission, January 1976.

The SOHIO project would eliminate 670 million cubic feet per day of El Paso capacity, but would leave 3.13 billion cfd in the El Paso system. (National Energy Transportation, op. cit., p.218.) Total deliveries to California (Northern and Southern) by El Paso in 1975 were 2.544 billion cfd. ("10-Year Forecast ...", supra., p. II-1.) Thus, considerable unused capacity still exists in the system with the abandonment to SOHIO.

Alaskan natural gas pipeline without direct links to California, which might displace natural gas for delivery to California via the Southwest route. An absolute shortage of natural gas in California was forecast for the early 1980's and curtailments were already causing some utilities to substitute fuel oil when natural gas was unavailable. The Times article estimated that burning fuel oil in lieu of natural gas generates 100 times as much SO_2. Quinn wanted guarantees of continued availability of natural gas to avoid large scale dependence on fuel oil.

The direct air quality impacts of terminal operations were more immediate and certain, but their extent and mitigation was yet to be fully argued. Because the ambient air quality in the Los Angeles air basin persistently violates federal (and state) standards, it is classified as a non-attainment area under the Clean Air Act. New sources of pollution are prohibited from locating in such areas unless they can show "demonstrable air quality benefits." The means for such a showing is the so-called "tradeoff policy" -- a company must clean up existing sources of pollution (which would not ordinarily have been required to be cleaned up) in an amount to more than offset its own addition to the basin. Permits must be obtained from the local South Coast Air Quality Management District (SCAQMD), whose action is reviewable and reversible by the ARB, and the Environmental Protection Agency (EPA). Quinn thus has sufficient authority in law to halt a project if an acceptable trade-off cannot be worked out.

Quinn's stance on the project has been unremittingly pessimistic until recently, when a favorable agreement appears in sight. Perhaps the high water mark occurred just before a briefing of the California Congressional delegation. As reported in The Los Angeles Times:

> When asked if the state wants the project, Quinn replied: "I wouldn't say we want the project. The project does not have any benefits for the State of California. There are fewer than 100 jobs from the project.
>
> "At best, it will provide some additional air pollution. It's going to create the risk of large oil spills that could close southern California beaches." [11]

The oil spill issue is the weak sister to the direct air quality and natural gas pipeline preemption issues. While a major concern of such organizations as the Sierra Club, the uncertainties are such that the issue is difficult to deal with authoritatively. Quinn cites a SOHIO estimate that a major spill could occur every seven to eight years. [12]. The Port of Long Beach estimates that a major spill in the harbor might occur once every 64 years and en route about once every 110 years. [13]. Minor or major spills in the harbor itself -- a likely location -- would be less serious than amongst ecologically fragile Channel Islands. Spills contribute to air pollution through evaporation of the slick, but such a relationship is probably insufficient to establish any jurisdiction by the ARB, nor would state jurisdiction extend beyond three miles in any case. In effect, the state must rely on the Coast Guard in this area. The issue, nonetheless, exists and is a valid, if intractable, consideration in projects like SOHIO's.

In summary, three major concerns were identified by Quinn which made the SOHIO project problematic:

- Effects on the air quality of the L.A. air basin of oil storage and tanker operations (transit, unloading, purging/ballasting, and storage evaporation).

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[11] Los Angeles Times, July 27, 1977, Sec.I, p.21, col. 1.

[12] Ibid.

[13] Ibid., July 24, 1977, Sec. II, p.1, col. 1.

- Natural gas supply effects of converting gas pipelines from the Southwest for crude oil transshipment.
- Oil spill possibilities from the nearshore transit of crude oil tankers.

While each has received attention in the controversy, the air quality issued has dominated because it is the subject of permits directly under state control, because air quality is measurable (although the effects of deterioration are uncertain) and because the other two concerns reinforce the air quality issue.

3. A Summary of the Bargaining

Given the alternatives and their individual feasibilities and costs (as discussed in a later section), SOHIO gritted its teeth and engaged in a prolonged and, publicly at least, less than amicable bargaining process with state air quality officials. The acceptability of California's tradeoff policy was acknowledged early in the game. The policy was made a part of the Clean Air Act in the summer of 1977. But that policy provided little guidance for coming to terms. Several areas of contention developed within the tradeoff framework:

- What elements of the transportation system should be included in arriving at the total emissions?
- What level of operation of the system should be taken as the base for calculation?
- What are legitimate tradeoffs?
- How much more than a one-for-one pollution offset constitutes "demonstrable benefits?"

SOHIO's initial stance was that only the emissions from off-loading operations and subsequent storage and pumping of the crude should be counted; that the pollution burden be determined from average emissions associated with those activities; and that the displacement of foreign crude shipped in foreign tankers should be counted as a pollution offset. The company considered that its use of modern Jones Act vessels (equipped with fully or partially segregated ballast and gas inerting systems), modern storage tank technology, and self-imposed rules with respect to the use of low sulphur bunker fuel in port and to purging of cargo tanks, would result in minimal emissions. Sohio argued that these emissions would be mostly offset by the displacement of foreign tankers not similarly equipped and regulated.

The position of the ARB was that emissions should be considered to begin at Point Conception (approximately 120 miles north along the coast from Long Beach); that the additional power plant emissions for supplying the terminal with electricity should be counted; that the pollution base should be the "worst case" emissions from the system; and that displacement was too uncertain to be counted as an offset.

The tradeoff factor itself - the additional amount above the project's pollution burden that had to be cleaned up - was not as vigorously debated as was the composition of the burden itself. A 1.2 factor for daily emissions (1.2 pounds of pollutant cleaned up for every pound of pollutant emitted) was suggested by precedent in other tradeoff controversies and that number persisted with little apparent challenge [14].

While controversy over what the pollution base should be continued up until very recently, parallel attempts to assemble a package of cleanup proposals were being made. These attempts reflect, in concrete dollar form, the status of the bargaining over the pollution burden itself. SOHIO suggested a package in February 1977 aimed chiefly at mitigating hydrocarbon and particulate pollutants that would have cost an estimated $20-30 million. [15]. This was not considered nearly adequate by Quinn. A compromise was suggested in July by the Port which would have SOHIO accept the broader system definition (including transit and power plant emissions) and might cost between $30-80 million. [16]. This generated little enthusiasm. Finally, in September, Quinn pushed a proposal estimated at $75-125 million which included stack scrubbers on a local power plant particulates, SO_x, and NO_x

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[14] When the "worst case" emissions level was urged upon the South Coast Air Quality Management District (SCAQMD) by the ARB as the base for tradeoff calculations, SOHIO argued for a 1.0 factor to compensate for the higher base, but the real issue was the base, not the factor.

[15] Los Angeles Times, March 14, 1977, Sec.III, p.11, col.5.

[16] Ibid., July 30, 1977, Sec.II, p.1, col. 5.

pollutants [17]. Almost as much emphasis seems to have been placed on what particular cleanup projects were to be undertaken as on the tradeoff numbers themselves. An acceptable package (and thus, the coveted permit) seemed to hinge on the success of negotiations between SOHIO and Southern California Edison to install scrubbers on one of the latter's local power plants.

If ever a name has disguised the magnitude of a thing, the "scrubber" is a good example. The equipment Quinn had in mind was apparently a new design which by itself costs between $60 million and $100 million including (using one technology as an example) a piece of gear 60 feet high and 40-60 feet in diameter for each stack, storage silos for lime, retention basins for sludge and associated piping and pumps. The equipment would reduce sulphur compounds, particulates, and, in augmented form, nitrogen oxides, from the stack emissions of the power plant. [18]. Hydrocarbons from the SOHIO project were to be traded off via other cleanup activities already suggested by SOHIO (e.g., installing new technology in several dry cleaning businesses). In addition to the capital cost of the equipment, SOHIO and So Cal Edison negotiated operating and maintenance costs, ownership and tax liabilities. [19]. The latter could yet blow the lid off the negotiations, if such arrangements require some form of "gift tax" to be paid to the Federal Treasury.

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[17] Ibid., September 18, 1977, Sec.I, p.1, col.3.

[18] The emissions from the power plant without the scrubber are within current standards. In some ways, Quinn's insistence upon the scrubber appears to be rooted in a desire to test the equipment - at SOHIO's expense. Cost depends upon the technology and the size of the power plant.

[19] As of this writing, SOHIO and So Cal Edison have reached an agreement to install custom equipment at So Cal's 480 megawatt Alamitos plant. SOHIO's liability for capital and maintenance costs is limited to $78 million. Another $4 to $5 million will be spent by SOHIO to mitigate hydrocarbon emissions. Los Angeles Times, August 18,1978, Sec.1, p.1, col.1.

In the wake of bargaining, SOHIO decided to scale down its original proposal to reduce some of the pollution burden attributed to it. SOHIO currently proposes to build and operate two berths in the terminal [20]. (The Port still plans all three, the third being built by another operator, probably Macmillan Ring Free Oil Company.) The company will still use the pipeline at its intended capacity, but will sell the 200,000 B/D intended for local refiners using other currently existing facilities. This in essence narrows the operational base on which SOHIO's emissions burden would be calculated -- the 200,000 B/D would not be subject to permitting authority.

Of the large number of permits required, four important ones remain outstanding at the time of this writing. These are permits from the SCAQMD, the EPA, and Corps of Engineers and the California Public Utilities Commission (PUC). The SCAQMD has given "phase I" approval to the project and, presumably, once final approval is won from the state, the EPA permit will be pro forma. The Corps' dredging permits are customarily the last to be granted and pose no problem in SOHIO's case. The PUC has announced its intention to grant its permit. This situation has given rise to some hope that the controversy is nearing an end. However, the process is looking more and more like a practical example of Zeno's paradox.

The Citizens' Taskforce on SOHIO, a Long Beach group, has brought suit against the Port and the PUC charging that the state EIR is inadequate and has also obtained a temporary injunction against execution of a lease approved by the Board of Harbor Commissioners. Since the PUC is a party to the suit

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[20] The Port will no longer finance the terminal. The most recent published estimate of the project's cost is $575 million. (Ibid.)

(a situation forced on the Taskforce by legal maneuvers) the Supreme Court of California must decide what court has jurisdiction before any proceedings on the merits can begin. The suit does not preclude the PUC from issuing a permit, however. More importantly, a coalition of citizens' groups including the Taskforce will likely succeed in getting a referendum on the November 1978 ballot. That referendum will ask Long Beach voters to accept or reject the local ordinance authorizing agreements between the Port and SOHIO. The referendum brings new democratic volatility to the controversy just as the state was beginning to feel it could support the project. In fact, reacting to the prospect of a referendum, ARB's Executive Director, William Lewis, was reported to say: "the air pollution protection offered by SOHIO is 'more than acceptable to the citizens of Long Beach and the rest of the county.'" [21]. (Fortunately, from the perspective of the negotiators, the SOHIO project as modified via bargaining was approved by the voters.- ed.)

The California Coastal Commission (CCC) in granting its permit stipulated that no tanks be located on the pier because of earthquake hazards. This condition is subject to amendment if the Port (the applicant for the CCC permit) can show that the tanks are coastally dependent within the meaning of the California Coastal Environmental Quality Act. The Port has filed for such an amendment and the CCC should act on it soon. [22].

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[21] Ibid., July 31, 1978, Sec.II, p.l. The Governor was also enthusiastic about the project following the announcement of an agreement between SOHIO and So Cal Edison, August 18, 1978. See Ibid., August 19, 1978, Sec.l, p.l.

The "phase I" approval by the SCAQMD, while encouraging, merely establishes the parameters of the emissions tradeoff. An acceptable tradeoff package must be submitted before the permit itself is issued. [23]. That permit would be reviewed by the ARB and the EPA. Aside from the intricacies of the tradeoff negotiations underway, the scrubber may be of such magnitude in itself as to require an EIR and relevant permits (at least one from the CCC). No decision has yet been made whether such processes must be completed before construction of the terminal could begin (given acceptability of the tradeoff to air quality officials).

In view of these considerations, the controversy is by no means over yet. Administrative procedures could delay construction as much as another year.

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[22] A major consideration in moving all tanks inland was the inability of the ship's pumps to pump their oil that distance. Thus, booster pumps would be required in the pipeline. Such pumps would be a new source of emissions. The CCC asked the ARB for an assessment of the air quality impact of this change in the system. After study, the ARB concluded that: "The additional emissions, in our view, could well make the entire SOHIO project impractical. We therefore support the Port of Long Beach's request that it be allowed to construct the tanks on Pier J.", (Letter from Tom Quinn to Mike Fischer, Executive Director of the CCC, dated May 1, 1978). The ARB's opinion is necessary but not sufficient for a CCC decision. The CCC staff has determined that the inland location is feasible and the pier location undesirable. The Commission is faced with trading off its own concerns for air quality matters. The vote will be close. If the tanks are ultimately required to be moved inland, the stage is set for a new round of tradeoff calculations.

[23] Hearings on the SOHIO tradeoff package, including the So Cal Edison agreement are scheduled for September.

4. The Lengthy Cast of Characters

The review of the controversy presented so far has been from the perspective of the principals and has been directed toward highlighting the major substantive issues. Before addressing these issues in more detail in the following section, it is useful to introduce the rather large set of individuals and organizations who with varying degrees of intensity, were and remain concerned with the positions and actions of the principals. While lengthy, this list could be expanded to include virtually every individual in the nation, merely by considering consumer benefits. The list begins with a brief review of the principals and progresses through characters roughly in order of the intensity of their interests and participation.

SOHIO - At the cost of becoming a subsidiary of BP, SOHIO has become the major owner of crude oil in the United States. Using its majority interest in the Prudhoe Bay field, SOHIO borrowed heavily (probably close to $5 billion) to develop that interest. In late 1976, its debt was estimated to constitute 70% of its capitalization as compared to the normal 20-30% in the oil industry [24]. In such circumstances, the company had a substantial interest in maximizing the efficiency of its delivery system since transportation is the main controllable cost. Pennies per barrel become significant when multiplied by six orders of magnitude (a 165,000 DWT tanker carries on the order of 1.2 million barrels of oil). While costly (and getting more so as the controversy drags on), SOHIO's proposed terminal and pipeline could save in excess of $100 million per year in additional transportation charges relative to the Panama Canal route. By December of 1976, SOHIO claimed to have invested over $15 million in site selection and planning. [25].

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[24] Los Angeles Times, December 12, 1976, Sec. VIII, p. 7, col. 4.

ARB - The Air Resources Board had a substantial interest in the SOHIO project since net additions to the air pollution in non-attainment areas are prohibited by both state and federal law. Each state is charged by the federal Clean Air Act with producing a state implementation plan (SIP) to bring above-standard areas into compliance by 1987. Failure could result in loss of federal funds. California has pursued clean up measures aggressively and is well known for its stricter-than-federal automotive emissions standards. Having regulated mobile sources of air pollution (ARB's particular jurisdiction), and at about the time the SOHIO project was proposed, the ARB moved to force local air pollution authorities to control stationary sources (principally oil-related industries) [26]. SOHIO found itself at the leading edge of a crack down on the kind of pollution for which it would be responsible.

FEA/Department of Energy - The FEA became the tacit federal spokesman in the SOHIO matter. With responsibility for designing and implementing Project Independence, the agency's own concern was to see that North Slope oil contributed maximally to meeting U.S. energy demand. The Department of Energy was the only participant whose perspective was broad enough (by functional authority) to comprehend

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[25] Joint Hearings, Part II, op. cit, p.142.

[26] The ARB claimed that the local Southern California Air Pollution Control District was lax in enforcing standards and not stringent enough in its regulations (Los Angeles Times, February 26, 1976, Sec.II,p.4, col.1 and May 8, 1976, Sec.II, p.1, col.5). That District was reorganized by legislation effective March 1977 to become the SCAQMD.

Alaskan supply alternatives, nationwide supply needs, and overall energy economics. As federal spokesman, however, the agency was constrained to represent other federal concerns. In hearings held by the Senate Committees on Interior and Insular Affairs, and on Commerce, Mr. John Hill, Deputy Administrator of FEA, stated:

> ... it is simply a question of trying to sit down and decide the most efficient way there is to get that oil to the markets where it is needed, efficiency in terms of the environment, efficiency in terms of the consumer, and efficiency in terms of equitable distribution of this oil across the country. [27]

Alaska - The State of Alaska shares in the profits from developing its North Slope resources through royalties paid by the leaseholders. Royalties are calculated on the well-head price of the oil -- the delivered price less transportation costs. The lower transportation costs, the higher the well-head price and the greater the royalty. Alaska finds itself in accord, therefore, in any scheme that reduces transportation costs -- like the swap alternative and the SOHIO project. On the other hand, the state has been at odds with the oil companies with respect to the tariffs for use of the TAPS. These tariffs are, in essence, charges the leaseholders apply to themselves, since leaseholders and pipeline operators are substantially the same companies.[28] The higher the tariffs they set, the lower the well-head price and the smaller the royalty to Alaska. Senator Stevens' outspoken role in supporting Congressional action in the SOHIO controversy is explicable in this context [29].

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[27] Hearings, Part I, p.39.

[28] SOHIO controls 53% of the oil and 48% of TAPS.

The Port - Physically, Long Beach Harbor would gain a modern, relatively deep water, oil handling facility governed by strict environmental conditions imposed by various permits and the lease. While an arm of the city government, [30], the Port finances itself from tariffs imposed on cargoes and rent on wharfage associated with port facilities. It should receive about $2 million annually from the SOHIO terminal [31]. The Port has been active both in planning the facility and as the major co-sponsor of the state EIR. Both activities have been funded by SOHIO.

PUC - The Public Utilities Commission had a formal role to play because it had to approve the abandonment of the southern California gas segment of the proposed SOHIO pipeline. It was also the (minor) co-sponsor of the EIR. Because one of the major issues surrounding the SOHIO project was its impact on the supply of natural gas to the state, the PUC was also called upon to express concern over this issue. At least with regard to SOHIO's stage I project (500,000 B/D), the Commission was probably not overly concerned since other pipelines into California existed and compression in these could be increased if necessary to accommodate increased supplies [32]. Furthermore, other longer range sources were possible (the Alaskan Gas Pipeline, LNG and Mexican gas). Its interest was, therefore, basically technical, but despite a professed intention to issue the abandonment permit, it had not yet acted as of this writing.

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[29] See Los Angeles Times:
August 29, 1976, Sec. 8, p.1, col.3.
September 5, 1976, Sec. V, p.1, col.1.
September 22, 1976, Sec. I, p.3, col.5.
Joint Hearings, Part I, op. cit. passim
July 27, 1977, Sec. I, p.21, col. 1.
September 15, 1977, Sec. I, p.3, col.1.

[30] The City of Long Beach itself would gain additional tax revenues, enhanced demand for local business supplying vessels, construction jobs in the short term, and some small number of permanent employment opportunities.

[31] According to terms of proposed lease (Los Angeles Times, June 25, 1978, Sec.I, p.3, col. 1).

SCAQMD - This semi-independent agency has primary permitting authority over local stationary sources of air pollution in the Los Angeles Basin and eastward to the Riverside area. While its actions are reviewable and reversible by the ARB, the South Coast Air Quality Management District has had something of a mind of its own with which Quinn has had to contend by repeatedly forcing it to adopt stricter rules [33]. The state/local friction is probably independent of the SOHIO project itself and may derive from a greater sensitivity on the part of the SCAQMD to local economic considerations.

CCC - The California Coastal Commission, while not quite an ally of SOHIO, viewed the chosen location for the facility favorably and was the first state agency to issue a permit for the project. The Commission has an objective of minimizing industrial development in relatively pristine areas (except, as in the case of LNG, where the facility poses a danger to nearby inhabitants), in modernizing port facilities, and in reducing hazardous traffic and maneuvering activities in ports. In the SOHIO case, only the location of "surge" tanks [34] on the pier was problematic. On this question, the Commission may be in the position of having to trade off its more direct concerns against air quality concerns or dealing the project a considerable blow.

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[32] See subsection C.2. below.

[33] See subsection D.3 below.

Governor Brown - The Governor has avoided taking an active stand in the controversy. Presumably, if he wanted the project, he would have caused his bureaucracy to move more agilely to a decision. Rather than oppose it, the Governor probably saw the opportunity to turn the project into a benefit to the state (thereby scoring points for environmental sensitivity) and was content to allow Quinn to drive as hard a bargain as he could.

EPA - The federal Environmental Protection Agency remained in the background in the public controversy, allowing Quinn to make the case for air quality. Clearly its interest was in bringing the Los Angeles Basin within standards, but it wished this to happen through state action. Otherwise, the agency was represented in federal studies related to the SOHIO proposal and produced a couple of reports of its own describing the potential impacts of the project. While objective in tone, the latter never analyzed the net impact of the project or of not having it. The focus was on only half the ledger.

BLM/Department of the Interior - Because the pipeline contemplated by SOHIO crossed federal lands, SOHIO applied early (September 1975, even before Long Beach was selected) for a permit from the Bureau of Land Management. That agency became responsible for a Federal EIS. Portions of the pipeline (such as certain river crossings) were viewed as having significant potential impacts, but the project was engineered to minimize these and BLM's interests were not seriously transgressed. Early in the controversy, then-Secretary Kleppe advocated the exchange alternative [35], with Canada and Japan, but was ultimately overruled.

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[34] The Port claims that the tanks at the pier are not simply for storage, but are necessary for efficient unloading. The CCC questions this necessity. Hence, the quotation marks.

Public Interest Groups - Their primary forum for opposition was the series of hearings held between July 1977 and January 1978 by the SCAQMD. Concerns were as various as the groups and individuals seeking a hearing. Some feared another tanker explosion. Others opposed any increase in development of the Port. The principal well-known public interest organizations participating were the League of Women Voters (who requested the hearings) and the Sierra Club. These latter groups do not appear to have been in dedicated opposition, but were principally concerned with tanker traffic and oil spill issues which the supplemental EIR spent considerable time addressing. When the project was approved in principle by the SCAQMD, the local Citizens' Taskforce on SOHIO resorted to the courts to halt final approval. Its objections were that air quality impacts from the project would be felt locally whereas the tradeoffs were outside the impact area, that the project conflicts with local efforts to increase tourism, and that the EIR fails to deal adequately with seismic problems and the loss of natural gas to increase compression in non-abandoned gas lines. [36].

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[35] Los Angeles Times, September 5, 1976, Sec.V,p.1, col.1.

[36] Telephone interview with representative of Citizens' Taskforce.

City of Los Angeles - The Port of Los Angeles, also a branch of city government like the Port of Long Beach, was the loser in competition for the SOHIO project. As the controversy over the Long Beach site developed, the City Attorney's office became a perennial critic of the impact analysis associated with the project. Whether this criticism resulted from enhanced awareness on Los Angeles' part of project impacts, from sour grapes or from electoral politics [37] matters little: Los Angeles' role was strictly sideline.

President Carter - Despite evidence that the most efficient and locally most preferred method for distributing the benefits of North Slope oil was through crude oil exchanges with Japan and Canada [38], the President announced a policy against approving any export of North Slope crude or crude products. Presidential approval (with Congressional concurrence) of "exports" was required by the TAPS authorizing legislation. Perhaps significant in this regard is the fact that the main beneficiary of restricting North Slope crude to domestic trade is the U.S. Flag Fleet [39]. Recent coverage of the debate over the Cargo Preference Bill (H.R.

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[37] Los Angeles City Attorney Burt Pines was a candidate in the Republican primary for the 1978 gubernatorial election, but was defeated.

[38] The California Energy Commission analyzed the FEA draft North Slope oil transportation study and concluded that either the Kitimat terminal and pipeline or the swap alternatives were preferable to the SOHIO project (Los Angeles Times, December 1, 1976, Sec.I, p.3, col.5), Also, two (unspecified) advisors to the Governor met with energy experts on Carter's transition team December 3, 1976 to seek a Presidential finding in favor of short-term exchanges and consideration of longer term exchange agreements (Los Angeles Times, December 7, 1976, Sec.III, p.9, col.4).

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[39] The CRS report National Energy Transportation (op.cit.) numerated the advantages of exchange programs as addressing the Northern Tier problem (exchange with Canada) and as having lower transportation costs (exchanges with Japan). As disadvantages, they cited the loss to the U.S. Merchant Marine, the "increased likelihood of a major oil spill that could eventually reach the West Coasts of Canada and the United States," and that "another oil embargo could once again create an oil shortage ..." (Both quotations from page 247.) Since tankers would be transitting the North Pacific, the likelihood of a spill having much impact on the West Coast is slim. On the issue of embargo, the report ignores the existence of the Panama Canal, the strategic oil reserve program, and international agreements to share crude in the event of a general embargo. Only the impact on the U.S. Flag Fleet is unassailable.

1037) impled a strong campaign commitment on the President's part to advance the interests of domestic shipping [40].

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[40] Carter's support for the Cargo Preference Bill was subject to considerable partisan attack. While partisan, the critics adduced internal White House memoranda which explicitly urged support for the bill (in the face of agency opposition to it) on the basis of commitments to the industry. Reviewing memoranda from Stuart Eizenstat, the President's domestic policy advisor, and Robert Strauss, then-special trade representative, the _New York Times_ commented:

> Both state that support for the bill, though conceptually "flawed", was politically necessary in light of President Carter's campaign promises to maritime unions and the industry.

The _Times_ noted Secretary of the Treasury Blumenthal's objection to the bill on the grounds of its inflationary impact and the lack of support from the Departments of Defense and State. The _Times_ went on to report:

> Last October [1976], Mr. Carter, whose campaign reportedly received more than $100,000 from maritime interests, pledged support for a national cargo policy to assure American ships access to a "fair share of all types of cargo" in the nation's foreign waterborne commerce.

(_New York Times_, July 29, 1977, Sec.IV, p.1, col.6.)

The bill was defeated on the floor of the House on October 19, 1977. The President's policy against exporting North Slope crude, which because of the Jones Act guaranteed that traffic to the U.S. industry was announced in July 1977 - the same month as the partisan revelations above. That policy could serve as a fall back position supporting the industry in the event the Cargo Preference Bill failed.

U.S. Coast Guard - Under the Ports and Waterways Safety Act, the Federal Water Pollution Control Act and the Magnuson Act, the Coast Guard has primary responsibility for regulating interstate and foreign vessel traffic, vessel and port safety, oil handling operations and facilities, and for clean up in the event of oil spills. The ports themselves are responsible for their own development, wharf assignment to vessels and tariffs. In response to state concerns over oil spills due to increased Alaskan traffic and the air quality impacts of certain vessel operations (purging/ballasting) within the Los Angeles air shed, the Coast Guard has maintained an implacable confidence in the adequacy of its controls and the current impracticability of some state suggestions. As a result, State/ Coast Guard relations have been strained and the general tone of federal involvement in the controversy has been adversely affected.

IRS - An element of complexity in the SOHIO/Southern California Edison negotiations is the tax liability on the proposed scrubber. The Internal Revenue Service has become concerned with the issue as tradeoff policy transactions become more widespread. While the Service will not discuss or confirm that tax advice has been sought in the SOHIO case, it is reported to be considering the issuance of a ruling on "industrial gifts" of the sort necessary to achieve third party clean-up to offset new sources of pollution. The nature of that ruling may strongly affect the cost of the tradeoff policy to industry, thereby affecting economic growth and consumer prices. [41]

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[41] The potential tax liability on the proposed SOHIO/So Cal Edison scrubber was estimated to be as high as $40 million if taxed as a gift. In that case, the deal would be off. (Los Angeles Times, August 18, 1978, Sec.1,p.21, col.3.)

California Energy Resource Development and Conservation Commission - The Energy Commission has a large and explicit mandate to examine the implications of North Slope oil for California, in addition to energy resources in general. By some apparent division of labor, that mandate has taken a back seat to husbanding California's policy encouraging the development of alternative energy resources - alternatives to nuclear power in particular. Except when state agencies pulled together in the face of federal threats, the Commission has persistently taken a rationalist position with respect to the SOHIO project. The brunt of their written analyses has been an implicit indictment of the federal government for its lack of a coherent energy policy - resulting in California's being pressured to accept an energy facility about which it has serious reservations.

Office of Coastal Zone Management - OCZM's interest in the controversy, given its mandate, is to observe the functioning of a major energy facility siting process in which the "national interest" has been invoked and in which a state coastal zone management act and program are operating in site. The experience may provide insights into how coastal zone management practice relates to other state regulatory activities, economic growth, and the Federal system.

C. Substantive Issues

The state identified three concerns with respect to the SOHIO project -- its impact on air quality in the Los Angeles basin, its impact on the supply of natural gas to California, and its impact on the nearshore marine environment. The purpose of this section is to discuss these three issues in more detail, and given these three problem areas, to examine briefly alternative ways of utilizing SOHIO's 53% of the TAPS throughput.

To identify the principal arenas with the combatants, we have:

- State vs. SOHIO - While the economic benefits to the state from the SOHIO project were perceived as insignificant, the benefits to SOHIO were perceived to be large. By way of the tradeoff policy, the state sought to gain as large a portion of SOHIO's potential benefits for itself as it could justify in the tradeoff framework. The air quality impact factors were thus juggled to produce a maximum payoff in terms of reduced pollutants.
  Other than the Port, no governmental officials in the state perceived any particular benefit from a terminal sited in California. If the terminal were to be sited in the state, the Coastal Commission was favorably disposed to locating any such new facilities in already developed areas. The ARB, on the other hand, was disposed against locating new sources of pollution in chronically substandard (usually developed) areas. Without a positive interest in seeing the terminal sited, this inchoate conflict never developed.
- State vs. FEA/DOE - California has traditionally used natural gas to produce electricity. Forecasts of shortages of natural gas in the early 80's implied

a larger use of dirtier fuel oil. The state sought to extract a guarantee from federal regulatory authorities that adequate natural gas would be available to California utilities. The abandonment of a gas line as part of the SOHIO project provided an occasion for the state to press for such a guarantee.

- State vs. Coast Guard - States have little authority over the tankers which use their ports. California felt that stricter regulations were needed (especially for the practice of "purging") and sought either to force the Coast Guard to tighten its controls or to win direct authority for the state.

The SOHIO project was threaded through all three arenas. Despite this, SOHIO by its own concessions could not meet all of the state's objectives. Only with respect to natural gas supply was it able, however, to avoid making such concessions as it had the power to yield. SOHIO both participated and was a pawn in these separate bargaining arenas -- separate in that tradeoffs among them either have not occurred or have not been successful in resolving the SOHIO controversy.

1. Air Quality

The principal bargaining arena has been air quality. The Clean Air Act and state law have established standards and a timetable for achievment. The SOHIO project will emit hydrocarbons,sulphur oxides, nitrogen oxides and particulates. The absolute standards are not important here [42] -- only the fact that they are significantly exceeded in the Los Angeles air basin and that the SOHIO project as originally proposed was expected to augment the problem: sulphur and nitrogen oxides, and particulates are produced by the burning of fuel oil by tankers for power and by the pumps which move the crude through the pipeline. Hydrocarbons can be emitted during tanker operations (offloading, purging/ballasting, lightering) or by evaporation from storage tanks.

The rates by which the pollutants are emitted at various points in the system did not appear to be a major source of controversy even though some of the data was recent and sparse. The first measurements of fugitive emissions from valves and fittings had only just been made in connection with a California Office of Planning and Research (OPR) study of offshore oil operations begun in the summer of 1976. In addition, evaporation from oil storage tanks had only recently been realized and measured.

Early in the controversy, storage tank emissions were considered the most significant source of pollutants, which may account for the attention given to hydrocarbons at that time. Part of the lore of this earlier period is the "gap flap." The emissions from storage tanks were attributed to a gap between the floating roofs and the sides of the tanks. The ARB insisted on strict rules on the size of the gap and chided the Southern California Air Pollution Control District (now SCAQMD) for not being tough enough on the oil industry. [43]. Tank manufacturers claimed that they could not meet the tolerances required by the ARB. The result was a joint research effort by SOHIO, the ARB and the EPA [44] which showed that the size of the gap was not critical -- emissions from existing tank designs were more or less constant. The research came up with a partial solution to the evaporation problem, however. A second seal attached to the roof considerably reduced escape of vapor into the atmosphere.

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[42] In contrast to the air quality section of the preceding lease sale #48 demonstration analysis, the discussion here concentrates on standard violations rather than air pollution induced damages. The two perspectives are very different - one rational and economic; the other legal and practical.

In addition to evaporation from storage tanks, the practice of "purging" vessel cargo holds was singled out as a major source of hydrocarbons. Purging refers to the venting of hydrocarbon vapors from vessel holds to completely empty the hold. Such venting also occurs as the necessary consequence of vapor displacement by cargo, bunker, or ballast. In older tankers, purging could be a safety measure to rid empty cargo tanks of potentially explosive hydrocarbon vapors. [45]. Older tankers also put water ballast into empty tanks after offloading to lower the center of gravity and make ocean transit possible. Completely emptying cargo tanks is always necessary regardless of vessel age when the holds must be entered, as when they undergo maintenance. New vessels, Jones Act vessels, and those SOHIO would use are equipped with (fully or partially) segregated ballast and gas inerting systems

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[43] Los Angeles Times, May 8, 1976, Sec.II,p.1, col.5.

[44] Final report dated November 18, 1976.

[45] The Sansinena exploded in Los Angeles Harbor when a series of structural defects combined to link up a spark in an electrical device with an empty, but unpurged, tank.

(vessel stack gases are piped into the tanks to prevent an explosive oxygen/hydrocarbon mixture from forming). Even with gas inerting, purging is accomplished, usually at sea, to eliminate the trapped vapors.

Quinn demanded rules against purging in port or within the Los Angeles air shed, but was unsure of the state's legal authority to promulgate them in ocean waters as part of an air quality permit. The Coast Guard was not receptive to any such rules because purging is basically a safety measure. Even if the state could promulgate such rules, Quinn realistically wondered about the feasibility of monitoring and enforcing them.

In any case, SOHIO was willing to commit its own vessels not to purge in the Port. Self-regulation, modern tankers, and new storage tank technology combined to reorient the focus of the emissions debate. The topic of debate shifted to whether certain sources of emissions were relevant to the SOHIO project, whether certain emissions had an actual impact on Los Angeles basin air quality, and the operational scenario to be used as the base case.

The principal remaining sources of emissions identified by the ARB were the burning of fuel oil by vessels and the power plant supplying electricity to the terminal. The power plant emissions question is inherently political. There is no question that power plants emit pollution or that the terminal would use power. The questions were whether these second order emissions were legitimately attributable to the project, and if so, whether the burning of gas as fuel oil should be assumed. That is, the power plant would not always be burning oil, although oil is the marginal fuel.

The actual impact of transit emissions, however, has a technical dimension. The extent to which such pollution would flow into the Los Angeles basin is uncertain. Existing models only indicate general prevailing winds, providing only gross support for a landward impact. Possible absorption of the hydrocarbons in the ocean is not taken into account. Even in the Port, hard evidence is lacking on the actual geographical impact of terminal emissions. Assumptions about the air flow are based on a single experimental balloon trip on a single day. No more accurate micro-mesoscale models exist. Such data as does exist was obtained late in the controversy when an EIR supplement was assembled. No attempt at a probabilistic treatment of the transport of pollutants was attempted [46]. Not only is actual impact uncertain, but the total emissions at the source (such as a transitting tanker) are made part of the pollution burden to be traded off. No administrative distinction is made between an "emission" and an "impact."

Nonetheless, the ARB still claims that 100% of the tanker emissions, some of them released as far as 30 miles offshore, will impact the coast -- either the South Coast Air Basin or Santa Barbara and Ventura counties. Both SOHIO and the South Coast Air Quality Management District have estimated maximum impact percentages of two-thirds during the day and one third at night. The percentage chosen is no small matter since these tanker emissions are calculated to be the largest source of SO_2, PM and possible NO_x that are assigned to the project.

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[46] The EIR recognized the problem, at least, stating:

> Only a portion of [the transit emissions] actually are expected to impact the shoreline ... Ambient meteorology, the physical and chemical nature of the pollutant species, and the ability of the ocean to act as a chemical "sink," all interplay with each other and have a direct effect on the degree of transport of tanker emissions.

The second major area of diagreement over methods of emission calculation centers around the ARB's demand that the level of pollutants that SOHIO should remove each day via its offset expenditures is the maximum amount of pollutants estimated to be produced only once per month (i.e., having a 3% probability of occurrence). SOHIO has argued that the average daily emissions that it be charged to clean up should be based upon the average daily emissions that it creates. The very large difference in the level of these two methods can be seen in Table II.C.1. The daily average is usually less than one half of the maximum monthly projection (the maximum operating mode).

With random tanker arrivals, the maximum operational level consisted of the terminal receiving fuel-oil-generated electricity, occupied by two of the largest SOHIO vessels, simultaneously unloading 2.3 million barrels of oil, with two vessels underway between the Port and Point Conception. According to the model, this level of traffic would occur 3% of the time (roughly once per month). SOHIO argues that such a situation would not occur by virtue of the kind of dispatching SOHIO (and any other company) would practice [47]. Their estimate of the most likely case would be one vessel arrival every 1½ - 2 days. Nevertheless, adding up the emissions according to this "worst case" scenario (which even without dispatching would occur only once per month) yields the pollution base for the tradeoff. The tradeoff stipulated by the phase I approval of the SCAQMD is that 120% of this base must be mitigated daily. This mitigation must equal or exceed an annual mitigation of 200% of the SO_x, NO_x and particulate

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[47] SOHIO points out that four vessels within Point Conception represents 36% of their fleet concentrated in less than 10% of the 2200 mile route, a situation possible only with an especially incompetent dispatcher. (Personal interview.)

Table II.C.1

SUMMARY OF SOHIO PROJECT AIR EMISSIONS[1,2]

Activity/Pollutant kg/day	THC	SO_2	NO_x	PM	CO
Storage:[3,4] (winter-summer)	181-272	-	-	-	-
Fugitive:[5] (daily avg.-max. operating mode)[6]	39-88	-	-	-	-
Bunkering: (daily avg.-max.oper.mode)	.7-2.66[7]	-	-	-	-
Fuel Consumption (in port):[9] (daily avg.-max.oper.mode)	16-61	416-891[8]	219-1016	39-147	2
Tugboat Emissions: (daily avg.-max.oper.mode)[6]	2-6	5-17	61-250	2-11	9-37
Electricity Generation (daily avg.-max. electricity demand)[10,11]	55-69	378-898	351-867	88-187	
Sub-Total	294-499	799-1806	631-2133	129-345	11-39
Fuel Consumption (in transit:[12] (daily avg.-max.oper.mode)[9]	23-55	615-1374	372-789	120-148	5
Total	317-554	1414-3180	1003-2922	249-493	16-44

Notes:

1. Values for operation of two berths with daily throughput of 500,000 bbl.

2. Not included are discretionary (purging and ballasting) and accidental emission sources (oil spills).

3. Assumes 8-615,000 bbl storage tanks (3 at pier J, 5 at Caltrans).

4. Includes standing and wetting losses.

5. Fugitive emissions include losses from sump tanks, deaevators, pump and mixer seals, and pipeline valves.

6. Maximum operating mode assumes 2-120,000 dwt tankers bunkered the same day.

7. Maximum operating mode assumes 2-165,000 dwt tankers in port (having a probability of happening 2 days per year).

8. Assumes .5% S fuel burned.

9. Maximum operating mode calculated for maximum emissions expected to occur once every month.

10. Assumes average daily demand = 609 MWH.
    maximum daily demand = 762 MWH.

11. Average value equals minimum value of four methods of calculation.
    Maximum value equals maximum value of four methods.

12. Emissions to Point Conception.

emissions and 720% of the hydrocarbon emissions. Clearly, hydrocarbons will have to be mitigated at a greater than 120% daily rate to meet the latter requirement. Under these conditions the SOHIO project would, indeed, cause demonstrable air quality benefits. Moreover, since any displacement of imported crude delivered by foreign vessels cannot be counted as a tradeoff, any such displacement is a further external or "hidden" benefit.

The end result of the offset negotiations is that if recent ARB/SOHIO agreements stand, SOHIO will be charged with the daily clean-up of from two to ten times its project's expected average daily emissions (Table II.C.2.). As mentioned above, this is 120% of the maximum monthly projected value (97% mode) of SO_2, NO_x and PM, and 720% of the projected maximum monthly HC emission.

The cost of these offsets for SOHIO is predicted to be between $80 and $100 million. SOHIO's grudging acceptance indicates that the project must still be more cost effective than alternative transportation modes, mainly transportation via the Panama Canal.

The purpose of the offsets seems mainly to distribute the cost of any new air pollution sources to the users of the goods and services of that new source, via higher prices. However, the transfer to certain consumers of costs which are significantly higher than the actual costs of the removal of a new source's emissions has no economic justification.

This hardline approach by the ARB may largely be in response to the provisions of the Clean Air Act. That is, California could lose all of its federal funding if the national air quality standards are not met in the near future. The air quality laws as they now stand allow little or no flexibility in being able to trade off even a small level of air quality for the attainment of other benefits (e.g., economic, social), no matter how significant. Once

Table II.C.2

SOHIO Offset Emissions and Projected Project Emissions

	HC	SO_2	NO_x	PM
		kg/day		
Offset Emissions[2]	2950	2800	3230	550
Projected SOHIO Emissions				
- Daily Average[2]	317	1414	1003	249
- 97% Mode[3]				
EIR data[2]	554	3180	2922	493
SCAQMD[4]	570	1640	1820	180

Notes:

1. From a conversation with Bob Schadt (SOHIO), 7/8/78.
2. See Table I for more detailed calculations.
3. Maximum emission level expected to occur 3% of the time (once per month).
4. From "Supplement # to Staff Report, New Source Review of Proposed SOHIO Petroleum Terminal, Long Beach, October 25, 1977," SCAQMD, Table 25, p. 99.

again, the irrationality of rigid standards is apparent.

Another ramification of the present offset policy is that it is rapidly creating a very scarce resource -- namely old pollutant sources that can be cleaned up relatively inexpensively. As offsets costs increase, the rate of industrial development must decrease. Of course, this may be precisely the intent of offset policy in non-attainment areas.

Comparing the projected emissions from the operation of SOHIO pipeline and terminal (Table II.C.1) to the present emissions that the project would eliminate, reveals a remarkable conclusion. Recent studies have shown that the operation of terminal and pipeline will actually significantly reduce the amount of HC and SO_2 emissions in the L.A. basin. As can be seen in Table II.C.3. there are presently two oil transport activities that cause emissions in the Long Beach area that would be eliminated by the SOHIO project. These are emissions resulting from:

- the average daily delivery of 200,000 bbl of SOHIO crude to Long Beach, and
- the bunkering of SOHIO tankers returning from the Panama Canal (≈ 300,000 bbl/day capacity).

The tankers that presently deliver SOHIO oil to Long Beach are largely 80,000 dwt non-segregated ballast tankers. These tankers must take on water (ballast) as they unload in order to remain stable, displacing pollutant vapors. Any tankers delivering oil to the SOHIO terminal must have segregated ballast capability, which reduces the amount of displaced vapors. Furthermore, all tankers delivering oil to the SOHIO terminal must utilize .5% sulphur fuel in port, compared to the present use of 2% sulphur fuel. As might be expected, this regulation decreases SO_2 emissions per barrel of fuel consumed by nearly a factor of four.

Table II.C.3.

Present Air Emissions Eliminated By The SOHIO Terminal[1,2]

Activity/Pollutant	THC	SO_2[3]	NO_x	PM
		kg/day (daily average - emissions per call)		
Oil Delivery to San Pedro Bay:[4] (200,000 bbl/day				
In Port[5]	323-908	672-1888	110-308	40-112
Transit[6]	427-1200	1060-2976	162-456	63-176
Bunkering Visit for Panama Canal route:[7] (300,000 bbl/day				
Transit	9-35	760-2920	115-440	44-170
Hoteling	1-2	52-200	4-15	3-10
Tugs and Barges	1-5	3-10	31-120	1-5
Total: 8,9				
CTARP	761-2150	2547-7994	422-1339	151-473
SCAQMD (max.oper.emissions per call)	(-2500)	(-9090)	(-1636)	(-545)
(Projected SOHIO Project Emissions)10 (daily average - max. oper. mode)	(317-554)	(1414-3180)	(1003-2922)	(249-493)

Notes:

1. Calculations based upon SOHIO EIR data, Vol. 5, part 1, pp. XVII-7, XVII-16, 17.

2. a) SOHIO oil delivery to San Pedro Bay of 200,000 bbl/day.
   b) SOHIO shipment of 300,000 bbl/day via the Panama Canal.
   c) First emission value for each activity and pollutant is the daily average (total yearly emissions/365). Second emission value is the emissions per call.

3. 2% sulphur fuel.

4. 80,000 dwt tankers making 130 calls per year to deliver 200,000 bbl/day to the Port of Long Beach. Tankers would be uncontrolled, having no segregated ballast, and no inerting system.

5. Includes emissions from storage, fugitive, fuel consumption and tugboats.

6. Transit from Point Conception to Long Beach to Point Conception.

7. a) SOHIO oil delivery to Panama Canal of 300,000 bbl/day.
   b) Shipment made by 165,000 dwt tankers (95 trips/year). The actual present SOHIO fleet is composed of 3-265,000 dwt, 2-262,000 dwt, and one 120,000 dwt tankers. This fleet probably causes higher emissions/call but lower daily average emissions due to the lower number of calls and the greater efficiency of most larger tankers in fuel combustion.
   c) All SOHIO tankers bunker in Long Beach.
   d) 2% sulphur fuel.

8. Larger value for each pollutant is in kg/call and assumes one ship unloading and one ship bunkersing at the same time.

9. Values in parentheses are the 97% (maximum mode operation) values calculated by SCAQMD (Supplement #3 to staff report, "New Source Review of Proposed SOHIO Petroleum Terminal, Long Beach," Oct.25, 1977.

10. See Table II.C.1.

The increase in NO_x emissions with the SOHIO proposal is largely due to the increased maneuvering time and number of tugs required to dock the full tankers that are presently only bunkering when empty.

These estimates for the "no project alternative" may be low because they do not consider some sources of emissions that are included in the project emissions' calculations (i.e., electricity generation, fugitive emissions). These estimates also are not based upon a 97% maximum. The SCAQMD did a study where the monthly maximum was calculated. These figures are as expected even higher than those calculated above (Table II.C.3., note 9).

Other oil companies have been viewing the SOHIO-ARB negotiations with a good deal of concern, being mindful of the tough precedent that is being set. At one point, it was reported that some oil companies had threatened to boycott SOHIO crude if it acceded to California's demands. Leaving aside the question of whether such a boycott could be carried out practically or legally, the threat certainly underscores their concern. The tradeoff policy itself is probably not the substance of that concern -- after all, without it, development in non-attainment areas would be flatly prohibited. On the other hand, the supplemental EIR concluded that, even without tradeoffs, the SOHIO project would actually reduce certain air pollutants.

Whether the pollution base without the terminal is greater or lesser than with the terminal is an interesting question from the point of view of externalities generated by the protracted bargaining process. Even more important to California, however, is that, whatever the relative impacts, the state does not have any control over the current operations and would have control if a terminal were permitted. And, in fact, as has been indicated already, bargaining concessions by SOHIO make the terminal nothing less than a boon to overall air quality in the Los Angeles basin.

This lengthy subsection and the earlier air quality discussion have touched on a variety of issues that warrant further emphasis. While it is beyond the scope of this study to attempt to resolve these issues, it is worthwhile, at least, to bring them to our readers' attention:

1. Is it equitable or economically efficient to count second order pollution effects against the primary developer? What is the boundary between first and second order effects?
2. For facilities whose emissions vary significantly over time, by what means can the base emission rate be calculated in an efficient and equitable manner?
3. Are there any non-arbitrary rules for determining an appropriate offset factor beyond "one for one?"
4. Is there any way of modifying previously agreed to trade-off packages, upon the receipt of new information or to take account of new conditions (e.g. improved or deteriorating technology)?
5. If land use objectives imply concentration of development and air quality objectives imply the reverse, how can these objectives be reconciled?
6. How can incipient conflicts between pollution and safety objectives by reconciled (e.g. the tanker ballast issue)?
7. What is the appropriate role for the public sector in assembling acceptable packages of clean-up

opportunities? [48]

8. Is it a matter of national policy that development decline to zero in non-attainment areas as the cost of clean-up opportunities escalates? Is hoarding likely to occur? Will this lead to further stress within the federal system?
9. What national policies exist regarding the anti-trust implications and the tax liability of developers who comply with the offset policy by making industrial gifts of pollution control equipment?
10. Is another review of the conceptual foundations of the Clean Air Act in order?

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[48] The SCAQMD proposed a more active role for government in developing a tradeoff package early this year. It suggested establishing a "clean air fund" into which permit applicants would pay and out of which the SCAQMD would finance the clean-up of small businesses which are not subject to state clean air regulation. (Los Angeles Times, February 13, 1978, Sec.1, p.1.) In the current controversy, Quinn took an active role by bringing SOHIO and So Cal Edison together (in what was characterized as a "shotgun wedding"). This has not worked out altogether well since neither company was eager to reach agreement (it took 11 months) and the negotiations may have been sustained only by considerable governmental pressure.

2. Natural Gas Supply

The natural gas supply issue is secondary to the air quality issue, but is rich in complications. California has traditionally used natural gas to generate electricity, a luxury made possible by previously ample supplies. Utilities can burn fuel oil but the ARB estimated that this emits 100 times as much SO_x. Over the long term, natural gas supplies to California from the Southwest have been declining because of absolutely diminishing supplies and interstate price regulation (producers can sell their gas intrastate at higher prices). A shortage has been forecast for California for the early 80's. [49] When the SOHIO controversy was at its height, severe winter conditions in the Northeast caused the Federal Energy Regulatory Commission (FERC) to curtail deliveries in favor of residential heating uses in that region. Since the price mechanism was unavailable to stimulate new production and allocate available supplies, California was forced to lobby the Federal Energy Administration (FEA) for guarantees of continued supplies, hoping to avoid large scale conversion of utilities to fuel oil and associated air quality problems.

In testimony before the Energy and Power Subcommittee of the House Interstate and Foreign Commerce Committee on August 19, 1977, Quinn and Robert Batinovich, President of the PUC, set out conditions for the approval of the SOHIO project. They said California was prepared to issue permits if:

> Our natural gas delivery system is protected, either by construction of a new oil pipeline by SOHIO, by an immediate federal decision to deliver Alaskan gas directly to California, or assurance that greater capacity will be in place at no additional cost to California rate payers.

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[49] "10 Year Forecast..." op. cit.

> Appropriate federal agencies, in cooperation with the state, adopt legally enforceable tanker controls to prohibit purging, gas freeing, venting and ballasting into cargo tanks while in the greater Los Angeles air shed ...
>
> Sohio works cooperatively with state and local agencies to develop a legally acceptable set of emission tradeoffs ... [50]

Furthermore, J.A. Stuart, Executive Officer of the SCAQMD was later reported as saying:

> ... he would recommend rejection of the SOHIO application "if there is no western leg" to the Alaskan gas pipeline - and current gas supply projections remain relatively unchanged. [51].

The Stage I SOHIO project would preempt one gas line from the Southwest to California. The line was available because of the diminishing deliveries. Quinn was concerned that should additional supplies be forthcoming, the pipeline capacity would not be available [52]. Quinn's critics claimed he was holding the SOHIO project hostage in his negotiations with the FEA. Quinn was not fully supported by other state agencies, since other lines existed and compression in these could be increased to make up for the loss of one line. But stage II SOHIO would preempt a second gas line which could have consequences for supply from the Southwest.

A good deal of attention was focused on the proposals for an Alaskan Gas Pipeline. If that line delivered Alaskan gas directly to California, the Southwest supply route had less importance. If California benefited from Alaskan gas by displacement, however, the Southwest route would again be a principal supply route. In this context, the state was unified in opposing the stage II project.

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[50] Los Angeles Times, August 11, 1977, Sec.I, p.16, col 1.

[51] Ibid.,August 21, 1977, Sec.I, p.3, col.5.

[52] Quinn early suggested that SOHIO guarantee to construct a natural gas pipeline to replace the abandoned one if more gas capacity was needed. SOHIO refused such a guarantee which would have effectively eliminated the principal advantage to the Long Beach site.

By November 8, 1977 a decision had been made to construct an Alaskan Gas Pipeline with a western leg to deliver gas directly to California. California's pressure on FEA for a guarantee of natural gas supplies in view of the forecast shortage may have been influential in this decision. One wonders whether the potential impact of deregulation of interstate gas prices was adequately considered in this decision. Given the snail's pace of deregulation legislation and the uncertainty of pipeline financing, a paper decision on the western leg may have been a cheap concession. Over the long term, LNG and Mexican gas in particular are candidates to relieve projected shortages. In the short term, milder winters and a saturation of intrastate demand have made more natural gas available to California. The issue of SOHIO's impact on natural gas supplies has, therefore, receded into the background. Problems in financing the Alaskan Gas Pipeline [53], siting an LNG terminal, negotiating for Mexican gas, and the weather could raise the issue anew. While a consensus seems to have developed that SOHIO's stage I proposal would have a minimal impact and stage II is moribund, the Citizens' Taskforce suit claims that inadequate attention has been given to the natural gas consumption required to increase compression in remaining gas lines. The issue is not dead.

A further legacy of the natural gas supply issue is its effect on the West Coast fuel oil glut. To mitigate the immediate and long-term air quality effects of using fuel oil to generate electricity, the ARB promulgated rules for the residual sulphur content in fuel oil burned by power plants. Originally set at .5%, the standard was reduced to .25% effective in March of 1977. [54] This contributed to the oversupply of below standard fuel oil on the West Coast mentioned previously, which has lowered prices and increased transient bunkering traffic in Long Beach Harbor. [55] More frequent bunkering visits increase hoteling emissions (from vessels idling while awaiting fuel), emissions from tugs and barges servicing the vessels, fugitive emissions from fueling equipment and emission from the venting of fuel compartments.

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[53] See John T. McAlister, Jr. and William K. Linvill, eds., Alternatives for Alaskan Natural Gas, etc. (Stanford University: CTARP, July 1976).

Changing the refinery process to correct for the standard would affect the demand for various crudes. Adding desulphurization facilities would make higher sulphur crudes more attractive because of their lower cost. As the CTARP 1975 OCS study stated:

> The amount of desulphurization capacity that exists in California and the Pacific Northwest will have an indirect, but important effect on the amount of North Slope Alaskan crude transshipped to the Midwest. Imports of [low sulphur fuel oil] and [low sulphur] crude will be needed to the extent the demand for them exceeds the output of desulphurization capacity. Such imports would free Alaskan crude for transshipment that otherwise would have been utilized in PAD[D]V had sufficient desulphurization capability existed. [56]

Without significant desulphurization capacity in those refineries processing North Slope crude, more Indonesian crude is used or more bunker fuel is produced -- neither of which is a desirable outcome.

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[54] Prior to the second reduction, Standard Oil of California had invested in desulphurization facilities in its California refineries designed to the .5% standard. The subsequent further reduction in the standard caused them some hardship.

[55] The Coast Guard estimated that 15-20 vessels per day are awaiting bunker fuel. (Telephone interview).

[56] CTARP, *The Impact on California's Coastal Zone*, pp.153-4.

A real loser in this scenario is California crude. Normally higher in both sulphur and residuals, it fights a war on two fronts. In a free market, these disadvantages would be reflected in significantly lower prices. In fact, lower prices are quoted for California crude. However, the federal entitlements program cripples the price mechanism. Refiners purchasing low price crude have to pay into a fund used to offset the price paid by users of cartel-priced imported crude. The intent is to equalize the price paid for crude, but it seems that inadequate consideration has been given to quality differences. As a result, refineries prefer North Slope crude with its lower entitlement payment, lower sulfur and lower residual yield.

The discriminatory effect of the entitlements program has been recognized and entitlement payments for California crude were reduced late in 1977. [57] As this was insufficient, DOE proposes a further reduction which is now in the "public comment" stage. Also being considered are temporary permission to export fuel oil and transportation subsidies to move California crude to Eastern refineries [58], both measures which lead one to reconsider the wisdom of direct controls over the energy system. Without artificial price controls and instability in sulphur standards, refiners might invest in desulphurization to take advantage of lower California crude prices. Alternatively, the increasingly expensive secondary and tertiary recovery of California crude might be exposed as inherently non-competitive. Unfortunately, with the current regulatory regime, it is extremely difficult to determine just which modes of production are economically efficient.

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[57] Time, May 15, 1978, p.78.

[58] New York Times, June 16, 1978, Sec.IV, p.5, col.1.

3. Marine Oil Spills

With respect to marine pollution, yeoman's service appears to have done in the EIR to explicate this possibility. [59] "Possibility" is appropriate. The EIR dealt systematically with the issue and, using fragmentary data and available theoretical analyses, developed a probabilistic treatment. Since no major vessel-related oil spills have occurred in Southern California, a frequency must be inferred from world-wide and non-California data. The importance of the issue with respect to allowing or denying the SOHIO project depends on how one values the near certain occurrence of a major spill within an uncertain interval of time. Rather than value this occurrence infinitely (and,hence, on this basis, reject the project), the state has, quite reasonably, focused on lobbying for authority to impose adequate preventive measures. Given the current regulatory and traffic situation, the SOHIO addition is distinctly marginal and, as demonstrated above, occurs to some degree whether or not the terminal is approved. The desire to control vessels goes beyond the SOHIO project itself.

Those most concerned with oil spills were public interest groups like the Sierra Club. That concern manifested itself on the issue of traffic control. Some felt that existing Coast Guard supervision of traffic control lanes was lax and that a vessel traffic system (VTS) was needed. Such systems are analogous to air traffic control systems and are in place in Valdez, Puget Sound and San Francisco. But the issue did not become dominant because of SOHIO's marginal contribution, Coast Guard adamance about the lack of total volume to justify such a system, and the low expected frequency of vessel accidents in the EIR analaysis. The most likely location for an oil spill to occur is in the Port. The Coast Guard is prepared to contain spills there and the SOHIO terminal itself is equipped with containment booms around each berth.

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[59] Volume 3, Part 3 of the draft EIR is dedicated to this issue.

For his own part, Quinn was primarily concerned with the practices of lightering, purging, and ballasting, which makes vessel regulation subsidiary to the air quality issue. Control of such practices in an air quality permit may be neither appropriate nor enforceable. As with oil spills, the principal government agency with jurisdiction is the Coast Guard. The federal government has preempted state authority in the area of tanker regulation. This preemption was recently affirmed in the Supreme Court decision striking down the State of Washington's attempt to limit the size of tankers in Puget Sound. Prior to that decision, the state made several forays into the area of tanker regulation which were rebuffed by the Coast Guard as naïve, unwitting, and beyond state authority. As examples:

- Quinn has suggested regulations to prohibit purging within the Los Angeles airshed and to require vapor recovery systems on vessels. (These could be considered naïve since purging is often a necessary safety precaution and since vapor recovery systems have not yet been engineered to fit on ships.) [60]
- The State Land Commission suggested that certain gas monitoring devices be installed on vessels. (This may be unwitting -- any such electrical devices can constitute a hazard where flammable cargoes are involved.) [61]

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[60] Personal interview with USCG personnel.

[61] Statement by Cdr. Jonathan C. Ide, USCG, before the California State Lands Commission regarding draft rules and regulations for marine oil terminal operations, November 17, 1977, p.4.

- Quinn urged the two Southern California air quality districts to adopt a model rule with respect to lightering operations which would have applied beyond ordinary state geographical and legal jurisdiction. [62]

In any case, the Coast Guard considers its inspection and monitoring, and air patrol activities to be adequate control. Some Coast Guard officers are privately dismayed at the lack of expertise within state government when it comes to vessel operations. They stress that their chief concern is safety which, by implication, cannot take a back seat to air quality. [60].

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[62] Los Angeles Times, December 19, 1977, Sec.II, p.1,col.5.

4. Alternatives to SOHIO's Long Beach Proposal

By the fall of 1976, it had become apparent to all parties that SOHIO's original Long Beach proposal would require severe modifications if it were to retain any chance of ultimate approval. This realization led many parties (and SOHIO in particular) to review once again the feasible alternatives for transporting SOHIO's North Slope crude to the East and Midwest. Five distinct options were discussed with varying degrees of seriousness: A deepwater port in central California, connected to an overland pipeline, the Panama Canal route, the Guatemala pipeline route, the Cape Horn route, and swaps with Canada or Japan. The purpose of this section is to describe briefly the advantages and disadvantages of each option as perceived by the principal actors.

- The Central California Coast Site

  Because of the already severe air quality situation in Long Beach, it is plausible to consider [63] constructing a marine terminal and connecting pipelines in the area of San Luis Obispo Bay (roughly midway between Los Angeles and San Francisco). This location would not be a non-attainment area, but would still experience some air quality degradation which would have to be offset. There is a question whether sufficient air quality tradeoff opportunities exist in the area. Rather than building in an existing port, this alternative would mean building an offshore, marine terminal.

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[63] The site had been considered among the alternatives before SOHIO narrowed its choice to Los Angeles/Long Beach. Its resurrection in September, 1976 was almost off-handedly accomplished by Quinn. He casually mentioned this alternative and state officials were sent scurrying to justify its viability.

Thus, SOHIO would be back to the drafting boards and unable to take advantage of existing facilities. The lack of existing infrastructure also implies a larger impact on the natural environment. More pipeline would have to be laid and the natural gas line abandonment would still be part of the project. This alternative also would permit a tie-in to Elk Hills production, as would the Long Beach location.

The effects to SOHIO, California, and the nation are summarized below:

- SOHIO would lose some sunk costs and incur new front-end planning and pipeline costs. Commitment to this alternative implies a new and uncertain round of permit proceedings, a new set of environmental impacts, and a new air quality tradeoff procedure.
- California would be compensated for any estimated environmental costs if it were to permit such a siting and would gain taxes as in the Long Beach location.
- The nation would gain efficiency and security benefits similar to those under the original SOHIO proposal but these would be delayed.

- Permanent use of the Panama Canal - Crude that is excess to the West Coast would be shipped via large tankers to the west entrance where it would be transferred to smaller tankers that can negotiate the Canal. The smaller tankers would then make delivery on the Gulf or East Coasts. This alternative entails a toll, a lightering fee, and an extra unloading loss. [64] The FEA estimated the transportation cost from Valdez to Houston at between \$2.14 and \$2.45/bbl via the Canal versus \$1.82 via the SOHIO pipeline. [65]

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[64] President's April 15, 1977 Report ..., op.cit., p.41.

[65] New York Times, September 21, 1976, quoted in Joint Hearings, Part 1, op.cit.

The number of "Jones Act" tankers required would be such that some subsidized vessels would have to be mobilized into domestic trade. Normally this can be done, by law, only for discrete periods of time. [66] It is questionable whether an increased North Slope flow (beyond the first plateau of 1.2 MMB/D) could be accommodated by the whole U.S. Flag Fleet (including subsidized vessels). This kind of pressure on U.S. Flag shipping could raise tariffs further increasing the cost of this alternative. [67]. In summary:

- SOHIO would incur the cost of longer distances, the necessity to lighter oil to smaller tankers which can negotiate the Canal, a greater operational loss due to the additional transfer, and the Canal toll. In addition, especially in view of the transfer of the Canal to Panama, future costs and access to the route become uncertain. Uncertainty also exists with respect to tanker tariffs and availability, especially given future plans to increase TAPS throughput.

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[66] National Energy Transportation, op.cit., p.236.

[67] The FEA reported that the U.S. Maritime Administration, SOHIO and Exxon:

> ... reached the conclusions that, first, there will not be sufficient capacity in the Jones Act fleet alone to carry Alaskan crude oil in 1978 at rates of 700,000 barrels per day of North Slope oil to the West Coast; 500,000 barrels per day of North Slope crude to the U.S. Gulf Coast; and 150,000 barrels per day of oil from South Alaska to the West Coast, and, second, there will be sufficient capacity in the entire U.S. Flag Fleet, if available [Construction Differential Subsidy] and [Operations Differential Subsidy] tankers are converted to domestic trade.

Also,

> The significance of U.S. flag tanker availability to this study is that the supply of such tankers will have a direct bearing on tanker tariffs between Valdez and other U.S. ports. Without the conversion of subsidized vessels to domestic trade, it could be expected that the substantially increased demand for tankers caused by the Alaskan trade would cause tanker tariffs to increase substantially over current levels.

President's April 15, 1977 Report ..., pp. 36 and 37.

- California would experience (perhaps slight) uncompensated degradation of air quality due to transit tankers calling at Long Beach for bunker and supplies. Also, any increase in the local market for North Slope crude would be filled using existing facilities not subject to permit restrictions.
- The nation as a whole would lose efficiency in its oil supply system (and potentially lose consumer surplus) and some security in supply given the vulnerability of the Canal to interdiction.

● The Guatemala pipeline - A company has announced its intention to construct a pipeline across Guatemala. Apparently, Gautemala is willing and does not require elaborate environmental assessment and permit procedures. The line could be completed before SOHIO's project, but would probably not represent much of a saving over the Canal and none over its own pipeline. In summary:

- SOHIO's revenues would probably be similar to the Canal alternative, but uncertainty with respect to future costs and access would be increased.
- California would probably experience uncompensated losses similar to the Canal alternative.
- The nation would lose efficiency comparable to the Canal alternative and lose more in security of supply.

- The Cape Horn Route - As a last resort, this alternative would allow use of VLCC's throughout the supply route (given operational deep water ports in the East and Gulf), but would nevertheless yield the highest per barrel transportation cost. FEA estimated the cost at $2.65 per barrel.
  - The cost of the extra distance is sufficient to exceed the transportation costs of other alternatives. In addition, minimizing these maximum costs is dependent upon deep water ports at delivery points. This is plainly unattractive to SOHIO.
  - The nation would experience greater losses of economic efficiency and because of the longer supply line, larger insecurity of supply.

- Exchanges of crude oil ("swaps") with Japan and Canada - This alternative may have been the principal reason the trans-Alaska route was chosen in 1973. North Slope crude would be shipped to Canada in exchange for maintaining Canadian supplies to the Northern Tier States.[68] Other North Slope crude would be shipped to Japan (probably on non-U.S. Flag vessels) in exchange for Japan's allocation of Middle East oil delivered on the East or Gulf Coasts. This would be the lowest cost alternative in terms of minimim transportation costs overall.[69] Lower transportation costs would mean higher revenues to the oil companies, the State of Alaska and the U.S. Treasury. The main objections against this alternative are that it might be erroneously interpreted as inconsistent with the policy of energy independence and that it would eliminate a source of business for the Jones Act fleet. In summary:

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[68] Prospects for an agreement with Canada are not good, so some system to supply the Northern Tier may still be required.

[69] The FEA estimated that the swap option would cost $.54 per barrel less than Canal route using Jones Act tankers and $1.34 per barrel less using foreign tankers. Some of this differential might be lost in order to get the Japanese to enter the deal and some of it would be offset by an duties imposed on the Middle Eastern oil in the exchange. President's April 15, 1977 Report..., op.cit.pp.

- SOHIO's transportation costs would be reduced to a minimum, assuming favorable negotiations with Japan and Canada.
- The nation would probably gain in efficiency of crude transportation, but would lose a major customer for U.S. Flag shipping. Security impact is debated, but any difference is probably insignificant vis-a-vis the SOHIO proposal. [70]

In lieu of other alternatives, the Panama Canal is the operational supply route. Use of the Canal began in the fall of 1977 as TAPS capacity reached about 600,000 B/D. SOHIO's estimates of the West Coast market appear to have been accurate.

In addition to questions of cost (sunk and new), SOHIO was reluctant to embrace the alternative California site because the state could give no firm assurance that the permitting process would be any easier there. While air quality problems would be less serious, other environmental considerations would come into play which could prove just as troublesome.

While the swap alternative was evidently the most advantageous for everyone except the U.S. Flag Fleet, it was effectively scotched (in July of 1977) by President Carter's policy not to allow "exports" of Alaskan crude or crude products.

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[70] Since the United States is committed to sharing its crude in the event of a general embargo, and the Canal route and the strategic reserve are available in the event of a U.S.-only embargo, the only security loss is that from some interdiction of the Canal or longer sea routes.

D. The Decision Process

1. Introduction

The fundamental purpose of this Study is to make recommendations directed toward improving the decision process by which the nation sites facilities. Volumes 1 and 3 present recommendations and their underlying conceptual foundations. The case studies of this volume serve simultaneously as a source of data and inspiration, and as a proving ground for the recommendations and analysis of the preceding volume.

Energy facility siting decisions are made via a complex multi-party process, as is certainly evident from the preceding review and substantive discussion of the SOHIO controversy. The purpose of this section is to analyze and critique the manner by which the principal public entities concerned with the SOHIO proposal went about developing their own views and interacting with each other. The critique is based on notions of economic efficiency and equity, and on the ideals of maintaining the nation's federal structure and its encouragement of private enterprise.

In the subsection following, relevant interest concepts are reviewed. Next, the interactions between officials of the various levels of government are discussed for the purpose of examining how the interests of each level were determined. Then, the references to the national interest in the SOHIO project are reviewed and critiqued. Finally, the notions of the national interest and bargaining as used in this Study, are discussed in relation to the SOHIO controversy.

Most visibly, the SOHIO project illustrates the problem of balancing values within both the federal and state governments. At the federal level, effective action has been vitiated by the lack of a well-defined interest in the project resulting from the failure to trade off the objectives of providing an efficient, timely and secure supply of North Slope oil to markets where it is needed and of improving air quality. The two objectives exist simultaneously but cannot be maximized simultaneously. To preserve clean air requires additional cost in the crude transportation system. To build a secure and efficient transportation system as quickly as possible may entail air quality impacts that are not thoroughly mitigated. In the absence of a well-defined interest in the project, the federal government let it be known that it wanted the project but did not take action to facilitate compromise or to make a tradeoff between preferences. The lack of positive action obviated a constructive national level role, or rather, delegated the decision to surrogates (Quinn for clean air; SOHIO for economic and security benefits). As a result, the federal government has realized no national benefits in either clean air or efficient and secure crude transportation and, in fact, has suffered losses.

The balancing of values within the two levels of government gets translated into a kind of ineffable conflict between them. The national level could not bring itself to act positively on the splinter issues over which it had jurisdiction and acted mainly to close off options or to discount state concerns. The state could not trust the federal government to be neutral, and, refusing to be bullied, pursued its perceived self interest. The psychosis inherent in this model derives from the tendency of the federal government to react in its several parts to individual issues. In disaggregated form, each agency speaks for its own policies and is prone to defend rather than cooperate in changing them.

Another set of issues involved in the SOHIO project has to do with the framework of the bargaining itself. The tradeoff is an immediately attractive solution to the problem of maintaining strict standards while allowing for economic development. The approach provides a general principle for reconciling these goals but provides little or no guidance for the process. Whether EPA ought to provide guidelines can be debated, but that agency presumably prefers that the states develop these on their own. The SOHIO experience may yield some precedents in this regard. The oil industry has been worried about the precedent that concessions of the sort being demanded would set. While the policy has worked elsewhere in the country, it is doubtful whether any other siting action has involved a tradeoff negotiation of SOHIO's scale.

Apart from some of these more novel aspects of the SOHIO controversy, its course graphically demonstrates some of the long recognized problems of a fragmented permit procedure at both state and federal levels. Even here the SOHIO controversy exhibits singular aspects. Upon agreement between SOHIO and the Port on the terminal proposal, a scramble among state agencies ensued for lead agency responsibility. The state's Office of Planning and Research (OPR) assigned that responsibility to the PUC and the Port jointly. That status was short-lived owing to the strong preferences of the ARB and the aggressive and privileged position of its chairman. While the Port and PUC continued to assemble the state EIR, Quinn became the nominal spokesman for the state. The air quality permit has been the lynchpin in the approval process. Nonetheless, each state agency with an interest in the project prepared its own staff analyses and held its own hearings. From the beginning there appears to have been little common intrastate direction.

Ad hoc coordination may have moved the process along but in the absence of well-defined procedural roles or positive interest on the part of the Governor, the controversy was dominated by the administrative agency with the largest stake whose preferences had little to do with minimizing delay in the process.

On September 30, 1977, the Governor signed Assembly Bill 884 to improve the procedures for review and approval of development projects in the state. While too late to affect the SOHIO project- this legislation could make a great deal of difference in future siting actions (including, perhaps, the scrubber if negotiated). The bill formalizes the lead agency concept, sets time limits for various processes, provides for explicit criteria for what constitutes a complete application, and encourages consolidated hearings and joint state/federal environmental impact assessment. At the least, the legislation puts some teeth in the lead agency concept by putting content in the notions of coordination and administrative responsibility.

The bill should be an object lesson to the Congress since similar conditions of fragmentation exist at the federal level which have kept it from speaking coherently in the controversy. While federal permits have been off the critical path, officials have been at pains to demonstrate that federal procedures would not delay the project. The Congress, for its part, has considered legislation (S.1868, 95th Congress, 1st. session, 1977), which would authorize the President to ask the Congress to waive any federal law in order to facilitate construction of the SOHIO and Northern Tier projects. Certainly delay at the federal level would be embarrassing given its tacit support for the project. (While not a source of delay, BLM granted its right-of-way permit to SOHIO July 25, 1978, a year and four months after completing an EIS.) Despite the state's effort to bring the federal government into the bargaining, little has apparently been done at the federal level (beyond appointing FEA and BLM project managers) to engage the two processes.

Perhaps at the heart of the intralevel and fragmentation and interlevel disengagement has been the environmental impact analysis function. The state EIR was completed in draft form after battle lines had been drawn and, until the decision to prepare a supplemental EIR (September 1977), was relatively ignored. Since the controversy was more over which emissions should be counted and under which operational scenario (political matters) than over their existence or rate of production (technical matters), [71] the EIR perhaps served the purpose of a reference and legal record, but as a coordinating mechanism or decision document it didn't really work.

In addition to, and separate from, the state EIR process was the federal EIS process. Begun in September 1975 and finished in March 1977, the Bureau of Land Management (BLM) produced an analysis of the whole project, comparable to the state document, for use in the federal permitting process. Aside from questions of duplication, two analytical efforts could confuse the decision process by producing different results from different data and different assumptions.

The last-but-not-least issue raised by the SOHIO controversy is how to increase the efficiency of conflict resolution in situations where facilities are of more than local concern. The SOHIO case illustrates the use of relatively unconstrained bargaining ("relatively unconstrained" because it took place in the tradeoff framework). Ultimately, the bargaining process became earnest in the long and intermittent series of hearings held by the SCAQMD between July 1977 and January 1978. During this period new staff studies were conducted and a supplemental EIR was prepared by the PUC and the Port. The result was an administrative finding on the pollution burden charged to the project and the criteria for a tradeoff. Bargaining has to recommend it that it produces a "market" solution. However, market solutions, while efficient, are not always viewed as equitable especially in the presence of monopoly power. Quinn had such power. Furthermore, the unstructured bargaining process produced externalities by way of its protractedness.

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[71] Additional technical work on mesoscale air flow and hydrocarbon transport modeling might have moved some of the political issues into the realm of technical fact.

There are alternatives. The legislative mechanism is always available to make ad hoc determinations about the applicability of federal laws to particular projects. Authority to override state resistance (as opposed to setting aside federal laws) may be constitutionally questionable, apart from the wisdom of further centralizing government. At the least, the Executive ought to be able to formulate a coherent energy supply plan to strengthen its position in dealing with a recalcitrant state. [72] The Congress might also establish some formal meditation/arbitration procedure, perhaps modelled on the recently enacted amendments to the Endangered Species Act, to resolve conflicts over projects in which they express strong preferences. It can be argued that Congress should invest more effort in rectifying Executive branch decision procedures as a long-run solution to energy facility siting controversies - and less effort resolving specific controversies by statute.

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[72] The FEA attempted a broad analysis of Alaskan North Slope oil transportation for the President's Energy Resources Council announced as final on November 31, 1976 (Los Angeles Times, December 1, 1976, Sec.1, p.1, col.1). It was never published and exists only as samizdat. H.R. 312 would direct the President to produce a comprehensive plan for Alaskan petroleum resources.

Finally, future guidance on the tradeoff policy itself through regulations or legislation might limit the scope for disagreement in certain areas and reduce uncertainties about tradeoff costs. On the other hand, such guidance must be careful not to reduce the room for locating mutually acceptable bargains by being overly specific and detailed.

2. Interest Concepts

Volume 3 of this study is devoted to a fairly rigorous analysis of the notions of individual and collective interests. A brief review of several of the concepts developed therein will facilitate the discussion of this section.

Preferences distinguish between good and bad alternative states of affairs. Interests distinguish between good and bad alternative realizable actions. Interests can be derived from preferences if the effects of alternative actions can be deduced, and so in this sense preferences are more fundamental than interests. Objectives fill the nether land between preferences and interests and may be thought of as action-oriented preferences or generalized interest statements. For example, most of us prefer higher to lower quality sound reproduction. This is easily translated into the objective of purchasing fine stereo system. However, to determine whether it is in one's interest to purchase a particular system at this time, a variety of other objectives, constraints, and alternatives must be considered simultaneously.

The determination of an individual's interest boils down to making the best decision. Despite the complexity of real decisions, techniques for best individual decision-making are well established. The situation for groups, like states or nations, is considerably less clear.

Volume 3 argues that the best action for a group is determined in accordance with the entire set of rules and procedures established by the group. This so-called process definition of collective interests in effect substitutes the group's implicit or explicit constitution for the knowledge and preferences of the individual in making interest determinations. Clearly, this process definition attaches great weight to the particular set of rules and procedures selected by the members of the group.

Specifically, the interests of the residents of California (and of the three southern air basins in particular) with respect to the SOHIO proposal have, are, and will be expressed in accordance with the objectives and authorities of responsible officials. This is because, with the exception of litigation, individuals have no authority to make decisions regarding the project - they or their forebears have delegated (or at least acquiesced to the delegation of) whatever primitive influence they had to a variety of governmental entities.

Depending on the intensity of their preferences, individuals may be concerned with the substantive positions taken by responsible agencies and seek to influence them in standard fashions (e.g., lobbying, referenda, contributions, etc.). However, the purpose of this case study is not to pass final judgment on the stands of any particular official regarding the SOHIO proposal, but rather to analyze whether the rules and procedures for governmental involvement are adequate to the task of evaluating the SOHIO proposal, and coastal energy facility siting proposals generally.

The question being raised is quite abstract. It is not whether the original or modified SOHIO proposal is in the national or state or local interest - this can be ascertained in principle using the definitions and techniques presented elsewhere in this study. Rather the question is whether the current rules and procedures of governmental levels facilitate the determination and realization of the interests of the collectives represented by the various levels. Not surprisingly, the answer is that the rules and procedures are woefully inadequate; consequently the "mind" of the collective is irrational to the point of psychosis; and only by coincidence are collective interest determinations centered with respect to the set of constituents' interests.

The following two subsections decend from this level of abstraction, but address the same issue. Directly, the next subsection recounts the nature of the interactions between various state and local officials (by which state and local interests are determined), between federal agencies (by which the federal interest is determined), and between these officials and the private sector (by which the national interest is determined).

Indirectly, it shows that it is in each individuals' interest to seek to rectify the current set of rules and procedures by which these various collective interests are determined.

3. Agent Interactions

- Intra-state agent interactions

The press was used for intra-state political purposes as well as to focus public interest on the SOHIO project [73]. If air quality was to be a highlight of the Administration, it had to be vigorously pursued. Thus, once Federal standards for automobile emissions had been bested, the ARB turned its attention to local rules and enforcement with respect to stationary sources of pollution. Stationary sources were the statutory responsibility of local districts and the ARB could involve itself only if it found the local effort inadequate. The Southern California APCD came under fire from Quinn as early as February, 1976 (two months after the SOHIO project was announced.)

The resulting dispute was officially resolved with legislation which reorganized the Los Angeles area smog district. The latter emerged in February of 1977 as the South Coast Air Quality Management District with somewhat less autonomy. That same month, the .25% sulphur standard for fuel oil burned in Southern California power plants was imposed by ARB. Chairman McCandless of the SCAQMD was quoted by the California Journal:

> We were on our way to correcting the problems in the district ... and then here comes along Tom Quinn, with the super-imposition of the ARB, its politics and its policies of regulation by oneupmanship and shoot-from-the-hip press releases. [74]

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[73] "Quinn is treating our pollution control the way he would a candidate he was promoting: pushing it before the public and praising its virtues. For Quinn, taking the fight to the public arena has its benefits and its risks. Without public exposure, we would accomplish nothing, he says. 'We haven't made the strides we have because industries have suddenly gotten religion, you know. And besides, if I make mistakes, its all right out there in the public for everyone to see'."

California Journal, The Pressure Tactics of Smog Boss Tom Quinn", (Vol.VIII, no.7), July 1977, p.226.

[74] Ibid.

The SCAQMD still has permitting authority, but Quinn is calling the shots on how that authority is exercised.

The reorganizing legislation also imposed new procedural rules on the SCAQMD. Hearings by such bodies were apparently not routine. Nor did the new legislation make them so; but, it did allow anyone to request a formal hearing and, further, required that such hearings be evidentiary in nature. The result in SOHIO's case has been a long but thorough examination of the project from July 1977 to January 1978, which led to additional staff studies, a supplemental EIR, and a decision on the parameters of the tradeoff. The intent of the evidentiary procedures was to build as firm as possible a record of adequate consideration of the project's ramifications in anticipation of court challenges.

That challenge came from a local group, Citizens Taskforce on SOHIO, which, clearly, did not give up when the SCAQMD gave tentative approval to the SOHIO project. On the other hand, the local branches of the national environmental groups, notably the Sierra Club, did not take an obstructionist stand. The latter's main concern was vessel traffic and oil spills. Since the CCC had determined that, at least within the harbor, traffic problems would be improved by having the new terminal, since the increase in traffic related to SOHIO was very small, and since air quality was not their major concern, little flak came from this direction.

The Taskforce ended up by suing the PUC, certainly because that agency was co-sponsor of the EIR, but also since it had not yet issued its permit. This is somewhat ironic in that the PUC's interest in SOHIO is small and it has not been the principal co-sponsor of the EIR. When an agreement between SOHIO and the Port of Long Beach was announced in December of 1975, there was a scramble among state agencies for lead agency status. The contest was decided by the Office of Planning and Research in favor of the PUC and the Port jointly.

The essence of lead agency status in this early context was responsibility for the EIR process. Such status did not apparently confer any special authority over the ultimate decision since other state agencies retained complete automony with respect to their areas of special concern. Initially, all relevant state agencies professed to cooperate with the joint sponsors of the EIR, but, perhaps quite naturally, the bulk of the responsibility was assumed by the Port. ("Naturally" because a consistent EIR by a weakly-chaired committee is difficult, if not institutionally impossible, to produce and because the main incidence of the effects, both positive and negative, devolved upon Long Beach [74A].) But the Port is favorably disposed to the development of Long Beach Harbor - other agencies could not be sure that their interests would be adequately considered, at least in the absence of any pressure on their parts to assure such consideration. Thus, because of the nature of the assignment of responsibility, particularly interested agencies (such as the ARB) had an incentive to act outside the EIR process to focus attention on their concerns. When the draft EIR was finished, it was reviewed by the relevant agencies, but such a post hoc mechanism provides minimal comfort or opportunity for establishing an issue as critical to the decision.

EIR and EIS procedures have an innate problem - the fox in the chicken coop syndrome. Interested agencies will naturally bias the analysis, if for no other reason than their limited expertise. A disinterested agency would not have the expertise or responsibility within the scope of its mandate. So, the check of review is necessary. Better yet would be mutual agreement among agencies on the issues to be investigated at the outset of the process and continuous oversight by a board of directors rather than a single agency, though a single agency might act as secretary and contracting officer for the board. As noted in Volume 1, such a system would

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[74] The cooperative impact analysis of Volume 1 urges rationality on all levels, but this need not imply consistent evaluations between levels.

limit the scope for legitimate appeal outside the decision structure.

As it was, Quinn felt it necessary to bring the air quality issue before the public in frequently dramatic form in order to make it unavoidable in the assessment and to force advocates of the project to marshall evidence on the issue. The result was to "politicize" the decision rather than allow it to become the outcome of a bureaucratic process.

- Intra-federal agent interactions

Like the state, the federal government was not unanimous in its view on the SOHIO project. The quality of the interactions was different, however, reflecting greater uncertainty with respect to the legitimate role of, and the expected net benefits from, the national perspective.

The clearest position that emerged prior to FEA's attempt to deal specifically with SOHIO was that, one way or another, North Slope oil should be used to decrease the country's reliance on foreign oil. On this, all were agreed - even California would not dispute the legitimacy of this interest.

The next step was to focus emphasis on the need for a pipeline to get the oil from West to East. The basis for the assertion of need can presumably be inferred from later testimony by FEA and the Navy to be efficiency and security. EPA made no overt public statements, though its reservations may perhaps be inferred from an analysis published in October. [75]. In a very balanced account of the SOHIO project, the need for a pipeline was never broached; nor was there any indication that the project was environmentally unacceptable given mitigating technologies and procedures. Thus, the Executive, being ideologically tied to the need for using existing domestic sources of crude and open to the possibility that air pollution could be mitigated, eventually came to a qualified endorsement of the SOHIO project.

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[75] Alaskan Oil Transportation Issues", U.S. Environmental Protection Agency, EPA-600/9-77-019, October 1977.

On the Congressional side, however, SOHIO was more apparently a bone of contention. Senator Stevens was an open and perennial critic of California's handling of the SOHIO project, no doubt in part due to the financial cost imposed on Alaska by the delay. At its most extreme, the Congress considered a suggestion by Senator Stevens that the federal government be given authority to override state objections to pipeline proposals. The suggestion was opposed by the Administration although a streamlining of federal procedures for pipeline route selection and approval was lately supported. The Executive was (probably unfairly) taken to task for not anticipating the transportation problems associated with North Slope oil. The private sector shared in the Congress' chastisement. [76]

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[76] A remark by Senator Jackson was oft-quoted:

> Examination of the information currently available indicates that there has been a breakdown in both Federal and private sector planning necessary to accommodate North Slope crude oil and to insure equitable crude oil distribution to all parts of the Nation.
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> Hearings, p.2.

- Intra-industry agent interactions

Industry has a term for the siting procedure - "running the traps." The procedure in most governmental jurisdictions is such that a potential sitor must pass through many gates before he is free to proceed. At each gate, the sitor faces a different set of gatekeepers with different sets of attitudes and interests, different criteria for the acceptability of a project, and different information requirements. The project faces rejection or long delay if these differences are not anticipated in two ways: in a sensitively designed project and a "thorough" environmental assessment. The former is easier than the latter.

It is safe to say that the development of the SOHIO project controversy has been watched attentively by others in the industry. California has established itself as the toughest among the states on air quality control. What happens with the project could set several precedents which the industry is not eager to see established. The tradeoff policy by itself is probably not the substance of that concern - after all, without it development in non-attainment areas would be flatly prohibited. The problem is in the perception that California has overstepped the bounds of fairness in applying the policy. Acceptance of the demands demonstrates that industry can be pushed further than other states might have thought and could lead to generally fiercer bargaining.

- Inter-agent interactions - state/federal

State/federal relations were frought with problems of jurisdiction. More accurately perhaps, the relations were fraught with a multiplicity of jurisdictions with no one agency explicitly in charge on either side. The federal government had jurisdiction over dredging (the Corps), rights of way across federal lands (BLM), tanker regulation (the Coast Guard), and interstate pipeline abandonment (NERC).

The state and the federal government shared responsibility for air quality (EPA, ARB, and SCAQMD). The state had jurisdiction over its coastal zone (CCC), intrastate pipeline abandonment (PUC), and rights of way across state lands (State Lands Commission). Thus, in certain areas jurisdiction mirrored the sovereign rights of the state and federal levels; in others, the federal government had mandated state control leaving itself little scope for influence, in still others, firm federal jurisdiction existed by preemption or firm federal supervision was possible. But at neither level did any agency have responsibility for energy facilities per se. Thus, the spokesman at the state level existed by virtue of his willingness to wield his controls aggressively and the spokesman at the federal level existed as ad hoc coordinator among several agencies. Clearly the former while possibly isolated, had more innate power over the situation. The power to refuse a permit is greater than the desire to grant one.

Because jurisdictions were mixed at the federal level, each agency with explicit authority spoke for its own interests when interacting with the state. In the cases of the Corps and BLM, interactions were unimportant to the extent they existed. With respect to the pipeline abandonment, the state lobbied the FEA heavily (and unsuccessfully), for some assurance of increased natural gas supplies. However, these concerns have played a significant role in the analysis of the desirability of a western leg to the Alaskan Gas Pipeline. Moderate winters recently have made natural gas more plentiful so that some of the impetus behind the supply concern has abated.

State/FEA interactions have not dwindled, however. Replacing the natural gas issue has been the entitlements program. Recently proposed regulations would lower the entitlements penalty on California crude so that the price to refiners would better reflect quality.

Another controversy is the West Coast (fuel) oil glut. Not being able to export fuel oil because of federal policy against exports of North Slope crude and crude products, residual fuel oil from the refining process is locked into the West Coast where it accumulates due to low sulphur standards and a preference for currently available natural gas. The new regulations would "temporarily" permit export. While the attempt by the federal government to adjust its regulations in the face of clear economic inequities is laudatory, one wonders at the mincing pace by which it was accomplished, and more generally, about the wisdom of direct control over the energy system.

The Coast Guard has jurisdiction over vessels in interstate commerce - jurisdiction which is perhaps even firmer given the Supreme Court's decision against the State of Washington's limitations on tanker size in Puget Sound. Quinn's concern about tanker purging was therefore aimed at getting the Coast Guard to promulgate regulations on this practice or, better yet, at getting state authority to regulate vessels. Some Coast Guard officers are also privately dismayed at the lack of expertise within state government with respect to vessel operations. Some of these oversights are attributed to a philosophy that technology can be forced by regulation. The Coast Guard favors cooperative R & D to develop needed technology before requiring its installation.

The Coast Guard does not monitor each vessel but depends on the patrols and random inspections of vessels and vessel operations to turn up violations. More sophisticated traffic control equipment is not deemed necessary in southern California because of relatively low traffic volume and relatively uncomplicated access to the Port. This may change with development of the OCS and the multiplication of offshore rigs posing hazards to navigation. [77]

State/Coast Guard interactions seemed to have brought out the worst in both agents. Eager to push a more stringent regulatory regime on the oil transportation system, the state made some naïve suggestions (prohibiting purging in port and installing vapor recovery systems on vessels) and urged local air quality officials to promulgate rules governing oil transfer operations which would extend beyond ordinary state geographical jurisdiction and beyond specific legal jurisdiction with respect to vessels. Both these efforts can be seen as attempts to force a stricter regime by forcing technology on the one hand and alterations in legal authority on the other. The Coast Guard reacted to state concerns with what appeared in public to be arrogance and disdain. This tone may be justified but does little to clarify the issues or for developing sympathy for the Coast Guard's substantive role.

State/Congressional relations have been somewhat rocky. The Congress had been used as a sword of Damocles over the head of the state by Executive officials but by the fall of 1977 official policy was against any preemption of state authorities. Nonetheless, there are indications that the Congress was growing impatient. Following a briefing by Quinn of the California Congressional delegation, two Congressmen (Anderson and Hannaford) requested Governor Brown to remove Quinn from further control over the SOHIO project decision. Congressman Sisk was reported to say: "I question the state's sincerity on this whole deal." [78].

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[77] Oil companies are seeking permits to install two rigs in the separation zone between the traffic lanes leading south from the Port. Permission is opposed by shippers but supported by the Coast Guard.

[78] Los Angeles Times, July 29, 1977, sec.1, p.3, col.5.

4. Net National Benefits and the Federal Interest

The criterion used in this Study to determine when the siting of a facility is in the national interest differs from the common notion of the national interest. The common use is generally rhetorical and corresponds to an unsubstantiated assertion that something is best or at least good for the nation. When pressed for proof, adherents of this notion furnish aggregate cost-benefit analysis which presumably show net national benefits. The idea seems to be that states and localities, as administrative conveniences of the federal government, or individuals, as good patriotic citizens, are morally obliged to suffer net losses in order to promote the general aggregative welfare. During discussion of the SOHIO project at the Western Governor's Conference, Governor Apodaca of New Mexico expressed this attitude clearly:

> In my mind, it really gets down to whether or not California is willing to accept some of the environmental cost - and I think a relatively small environmental cost - in order to meet a substantial national need. [79]

This Study has suggested elsewhere that this concept of the national interest is coercive and ultimately unworkable. The view derives at least in part from the reticence of economists to deal with multi-party decision processes and equity issues, from an unwarranted sense of power on the part of some federal officials, and the myopic tendency of some states with a large stake in a particular decision to enter into ad hoc alliances, which if successful could lead to an emasculation of the sovereign authorities of all states.

A brief review of the national interest statements made with regard to the SOHIO proposal will serve as evidence of the sterility of the net national benefits concept as a definition of the national interest. [80]

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[79] Ibid., September 3, 1977, §II, p.1, col.1.

The SOHIO project controversy is being played out before the backdrop of the controversy surrounding the TAPS. On the latter, the Congress spoke with a clear voice. Under pressure of the Arab oil embargo, the Congress declared that:

> ... early development and delivery of oil and gas from Alaska's North Slope to domestic markets is _in the national interest_ because of growing domestic shortages and increasing dependence upon insecure foreign sources.
>
> ... the crude oil on the North Slope of Alaska is an important part of the Nation's oil resources, and ... the benefits of such crude oil should be equitably shared, directly or indirectly, by all regions of the country. [81].

Both of these statements refer to objectives (early development and delivery, equitable sharing) and not specific realizable actions; hence, in a strict sence, they are not interest statements. Congressional concern for equity is, however, consistent with the distributional national interest concept employed in this Study.

Interest statements by the Executive were more equivocal, as befits their relatively greater concern for the details of specific decisions. It is easier to establish objectives than interests. While the draft FEA study of North Slope oil transportation issues did not make any specific recommendations, reporting on a meeting between Quinn and Secretary James Schlesinger, the Los Angeles Times wrote:

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[80] The calculation of net local, state, and national benefits does have value for determining local, state, and federal interests. The national interest involves the realization of all three levels of interest, as used herein.

[81] Joint Hearings, Part 1, op.cit., pp. 39-40. The TAPS authorization legislation is P.L. 93-153. Emphasis added.

[82] _Los Angeles Times_, December 1, 1976, §I, p.1, col.1.

> Schlesinger cited a "strong federal interest" in building at least one pipeline for Alaskan oil to the Midwest, Quinn said Friday. Quinn said he came away with the clear impression that Schlesinger favored the SOHIO project - if it did not create serious problems for California. [83]

Note Schlesinger's use of the term federal interest and his apparent willingness to consider the distribution of costs and benefits throughout the nation.

Several months later, the FEA clarified its view of the federal interest with an endorsement of the project which was used by the CCC in coming to its decision:

> The Commission finds that to do otherwise than permit the proposed oil terminal for receiving Alaskan oil would adversely affect the public welfare. The Administrator of the Federal Energy Administration has testified to the Commission that the project would fulfill certain national needs by helping to distribute to interior refining markets at least some of the Alaskan oil surplus that would otherwise exist on the West Coast; by helping to alleviate expected crude oil shortages in the northern tier and midwestern states. [84]

The use of the term public welfare connotes the aggregative perspective appropriate to adequate consideration of the federal interest and the use of the term national needs, while generally deceptive, can in this case be correlated with previously quoted Congressional statement of objectives.

The U.S. Navy had also become a factor since the Elk Hills Naval Reserve was ordered into production in the spring of 1976. The CCC reported:

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[83] Ibid., July 30, 1977, §II, p.l. Col.5. Emphasis added.

[84] From staff recommendation of late September 1977 ultimately adopted by the Commission October 19. Emphasis added.

> The Department of the Navy has testified in support of the project because the Navy prefers to transport oil from the Elk Hills Naval Petroleum Reserve through the proposed SOHIO project pipeline to Texas. The Navy has testified that the proposed SOHIO pipeline is in the best interest of national defense because it would enable the Navy to maximize distribution of its oil to the Mid-Continent and East Coast regions at the least possible transportation costs and over a land route not subject to sea-lane interdiction. [85]

No doubt the appearance of federal judgments was helped along by the presence of Congressional concern over the difficulties with the SOHIO project.

By September 1977, Congress was holding hearings on a bill (S.1868) to require a federal decision on pipeline routes by the following February. Senator Stevens urged an amendment to permit the federal government to preempt state authority over such projects saying: "The question is whether one state can stand in the way of a project in the national interest." [86] This statement has great rhetorical value, for who would suggest that California has the right to impose costs on the nation? Conversely, this Study suggests that the nation has no right to impose costs on California or any other state. This is particularly true when the surplus of national benefits is more than adequate to compensate the state in question - a consequence of the existence of net national benefits and the nested structure of the federal system.

Nevertheless, the SOHIO proposal was eventually seen as in the national interest in the net national benefits sense, even by many California entities. In addition to the CCC quotations presented above, the Los Angeles Times editorialized:

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[85] Ibid.

[86] Ibid., September 15, 1977, §I, p.3, col.1.

> If SOHIO's Alaskan oil were intended for use in California there seems little doubt that state authorities would be taking a more accommodating line on the Long Beach terminal ... This plan has prompted some state officials to take a far tougher and sometimes, overtly parochial, line toward the SOHIO project ...
>
> We agree with the Carter Administration's view that a new terminal at Long Beach to help handle oil shipped south from Alaska would be in the national interest ... [87]

Aggregative national interest statements like those quoted above have value only for the purpose of determining whether a proposal merits additional consideration. If there are net national costs (including the costs of foregoing the benefits of other projects competing for the same resources), then the proposal should certainly be laid to rest. But as the SOHIO project and many other major energy facility proposals have demonstrated, the existence of net national benefits is hardly sufficient to ensure implementation.

The reason, of course, is that the aggregate view ignores distributional considerations. Consequently, it is seen as illegitimate in the eyes of adversely affected citizens and state and local officials - illegitimate in the sense that the invocation of the national interest for such projects does not lead to positive decisions.

When an action has been determined to be in an individual's interest, the rational person acts accordingly and forthwith. When an action has been determined to be in the national interest from the net national benefit perspective, the nation does not always act accordingly and forthwith. Clearly something is amiss. In the final subsection, the concept of the national interest developed in Volume 3 is applied to the SOHIO situation.

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[87] Ibid., August 9, 1977 §II, p.4, col.1. Emphasis added.

5. Bargaining and the National Interest

Volume 3 of this Study proposes a more strict criterion for when the siting of a facility is in the national interest than the common net national benefits approach. A facility (like the SOHIO proposal) is in the national interest if an only if its effects are, or can be and are redistributed, such that each party with effective veto power finds the facility to be in its self-interest. This criterion is more strict because there are facilities with net national benefits which may nevertheless impose net costs on one party with veto power.

Fortunately, there is a close connection between the two concepts of the national interest. Because of the nested structure of the federal system (i.e., localities within states, states within the nation), it is generally possible to redistribute the effects of a facility with net national benefits such that each nested collective with single veto power will find the modified proposal in its interest (and hence not exercise its veto).

Unfortunately, this encouraging conclusion is severely compromised by the current assignment of authorities within levels, wherein several narrow purpose agencies (e.g., air quality, water quality, land use, etc.) are granted vetoes simultaneously. This practice hinders the siting of facilities with net national benefits because the possibility of redistributing effects such that the modified proposal is in the interest of all parties with veto power, declines dramatically as the number of parties increases, and more importantly, because trading off objectives is effectively precluded.

This Study argues that the natural way of making the necessary redistributions is via a bargaining process between the developer and the nested levels within the federal system, preferably preceded by a cooperatively prepared, decision oriented analysis that emphasizes the distribution of effects. The advantage of bargaining is that it occurs quite naturally in everyday politics and that it ties compensation proposals directly to the decision at hand. This is in contrast to the establishment of general impact funds which allocate money on a yearly basis, in proportion to the share of national activity, or by crude, aggregative statistics. [88]. It is worth noting that the Coastal Energy Impact Fund did not play a role in the SOHIO controversy, but that a modified proposal in the interests of all parties was eventually reached via bargaining.

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[88] Many of the arguments in favor of bargaining appeared during the "net adverse impacts - formula grants" controversy of the 1976 Amendments to the CZMA. The net adverse impacts approach would have used federal funds to compensate adversely affected localities according to ad hoc impact analyses, whereas the formula grant approach used more aggregative means. The latter approach ultimately prevailed for reasons of administrative simplicity. Bargaining has the advantages of the net adverse impact approach with the addition that the federal role is minimized with industry performing the bulk of the compensation. For a fuller discussion see:

Jeffrey D. Roughgarden and Gerald Sauer, "Comparison of Alternative Methods for Distributing Coastal Energy Impact Funds", Energy Facility Siting in Coastal Areas. Committee on Commerce and the National Ocean Policy Study, U.S. Senate. (Washington: U.S. G.P.O., December 1975, pp.121-6).

If proposals were not subject to modification, then in the case of SOHIO, the effective veto power of the ARB as exercised by Quinn would have been sufficient to kill the project once and for all. It is important to recognize that the rules and procedures of the nation(and the state of California in particular) are such that Quinn could reasonably veto the project in accordance with his statutory responsibilities. This is because Quinn has been given both the luxury of considering only one effect and a veto power to boot, and because at least from early analyses, the SOHIO project did appear at best marginal in the air quality area.

It has been argued elsewhere in this Study that the granting of veto power to agencies with narrow jurisdiction is downright irrational. But the fault here lies not with Quinn for exercising his authorities to pursue his statutory objectives; rather it lies with the legislatures and Congress who established this lazy mode of public decision-making.

Fortunately for all parties, Quinn chose (perhaps for political reasons) not to exercise his veto immediately. Instead he realized that the trade-off provision of the Clean Air Act was a vehicle by which he could appropriate a portion of the net national benefits (SOHIO's profits) to ensure that air quality in southern California did not deteriorate as a result of the terminal and pipeline. Bargaining commenced without much precedent or formal structure to ease the way, with the result that serious questions of equity were raised, and delays occurred which were costly to all parties.

The delays were costly to SOHIO and the nation because the inefficient and less secure Panama Canal route was used in the interim, and to southern California because the unregulated activities to be displaced by the SOHIO proposal (even without the tradeoff package) were later found to be even more polluting.

This latter point raises the equity issue. While it is generally agreed that a damaged party has the right to recover costs imposed on it, the SOHIO case is a bit different. Assuming that the original proposal was slightly advantageous with respect to air quality, was Quinn justified in extracting $80 million of pollution abatement equipment from SOHIO and the nation? Evidently, his actions were quite legal under the Clean Air Act and so the question is one of moral philosophy. The effect of air quality regulations in southern California is to establish Quinn as the sole owner of a non-substitutable resource needed by all new developers. Quinn used his monopoly bargaining power very effectively against SOHIO, presumably in accordance with the intent of the Clean Air Act.

Do uncertainties and weaknesses mean that bargaining is not the appropriate mechanism for making siting decisions? The conclusion of this Study is no. But the SOHIO controversy illustrates that simple advocacy of bargaining will not solve all problems. Bargaining needs to take place in a structure which ensures to the extent possible that the externalities associated with the SOHIO experience do not occur. Such a structure would need to speed the process to a conclusion and to provide reasonable assurance of an equitable outcome while maximizing the bargaining space for reaching agreement.

With respect to timing, the pace of bargaining can be influenced by legal constraints (such as California's AB884 process imposes) or by creating incentives (either positive, as with logrolling, or negative, by imposing costs for delay or failure to reach agreement in cases with significant net national benefits.). In the SOHIO case, responsibility for the lengthiness of the process must be distributed all around. Government at all levels has been slow and the refusal of compromise has made agreement difficult. On the other hand, recent delay has been due to the inability of

SOHIO and Southern California Edison to agree on a scrubber proposal [89]

An imponderable in the timeframe of the SOHIO controversy is the virulence of the public rhetoric from Quinn. While it is difficult to see how the use of the inflammatory press release could help the bargaining, it may not have actually hindered it.

As to equity in the bargaining process, this can be enhanced by making sure that the bargaining takes place publicly (but not by one-sided press releases) so that inequities are fully exposed. The notion of an eye for an eye raises some problems for bargaining. First of all, this notion reduces the scope of possible tradeoffs involving commitments to research in emission control technology or alternative energy resource development. Furthermore, from a pure bargaining perspective, it is undesirable to limit alternatives any more than ethics and morals require. Thus, while one would expect unanimity in prohibiting threats of violence, there is much to be gained by allowing offers to be made over a very wide scope of affairs. For example, it is reasonable to assume that SOHIO used whatever influence it had on FEA and the industry to assure California with future natural gas supplies. And finally, the lack of a defined modus operandi for the offset policy raises the questions noted in the subsection C.1 on air quality.

In a pure bargaining situation, the objective of the state would be (questions of equity aside) to extract as much of the potential profit from SOHIO as possible. Given the proprietary nature of the company's costs, that potential would be difficult to estimate. [90] The differential transportation cost between the Panama Canal and the SOHIO pipeline provides an easier estimate of what SOHIO stands to gain and hence also, an upper bound on what California could hope to extract. California could demand most of this differential and still leave SOHIO in a better position than it would be using the Canal. Using a combination of estimates, a differential of about \$.60 per barrel looks reasonable. [91] That computes to something in excess of \$100 million annually in extra cost using the Canal. [92] Coincidentally, the estimate on the cost of the tradeoff to SOHIO was given as a range between \$75 and \$125 million.

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[89] SOHIO and Edison were brought together at Quinn's insistence. Edison has been anything but enthusiastic about its part in the tradeoff negotiations. Utilities in general do not consider scrubber technology reliable and are reluctant to contribute to the possibility of its being imposed on them by regulation. One individual indicated that Edison had engaged in the negotiations under pressure from DOE.

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[90] A Los Angeles City councilman was quoted as saying:

> This project is an enormous economic benefit to SOHIO. It may be that the shareholders of SOHIO will benefit to the tune of a billion dollars. And the people of Southern California are going to pay for that. [Los Angeles Times, January 19, 1977, Sec.I, p.1.]

SOHIO reported net income for the first half of 1978 of \$160,000,000 (New York Times, July 26, 1978, p.D5.)

[91] FEA estimates (Joint Hearings, Part 1, op.cit.,p.33):
Valdez-Houston via SOHIO pipeline - \$1.82
Valdex-Houston via Panama Canal - \$2.14-2.45 (average \$2.30)

A.D. Little estimates (Los Angeles Times, September 5, 1976, Sec.I, p.1, Col.1):
Valdez-Midland via SOHIO pipeline - \$1.60
Valdez-Midland via Panama Canal - \$2.31

Using \$2.30 for the Canal route and the mid-point of the pipeline estimates yields: \$2.30 (Canal) - \$1.71 (SOHIO) = \$.59 differential.

[92] \$.60x500,000 B/Dx365 days = \$109,500,000. SOHIO has estimated the extra cost to be \$225 million (Los Angeles Times, Ibid.). However, because this extra cost reduces the well-head price of oil, there is an incentive to inflate the estimate.

What are the alternatives to a bargaining approach? The classical laissez-faire approach which would allow a company to design a facility and locate it so as to minimize its long run average cost without government interference, leaves external costs unaccounted for and ignores the Clean Air Act. A neoclassical approach might impose a pollution tax based on actual actual emissions and their associated impacts (health effects, oil spill clean-up costs, natural gas price effects, etc.). This places a premium on emissions monitoring and impact modelling. The SCAQMD suggested a variation on this theme. It would establish a clean air fund into which a sitor would pay and out of which the local district would finance various clean-up activities. This alternative would put a burden on the local district to find clean-up activities and focuses more on the money than the mitigation accomplished by it.

Another alternative is positive state siting of facilities with which California is experimenting in the case of an LNG terminal. Whether or not government proves better at the process than private enterprise, California has certainly given itself a dose of its own medicine.

Southern California Outer Continental Shelf
Oil and Gas Development: The Santa Ynez Controversy.

James L. Berger.

A. Overview.

The major oil and gas reserves on the Outer Continental Shelf (OCS) off the west coast of the contiguous United States are concentrated south of Point Conception in southern California in a radius of 150 miles from Los Angeles. Figure 1 shows the U.S. Geological Survey's estimates of the recoverable reserves available in the OCS tracts that are already leased in that area. The tracts are outlined in heavy lines.

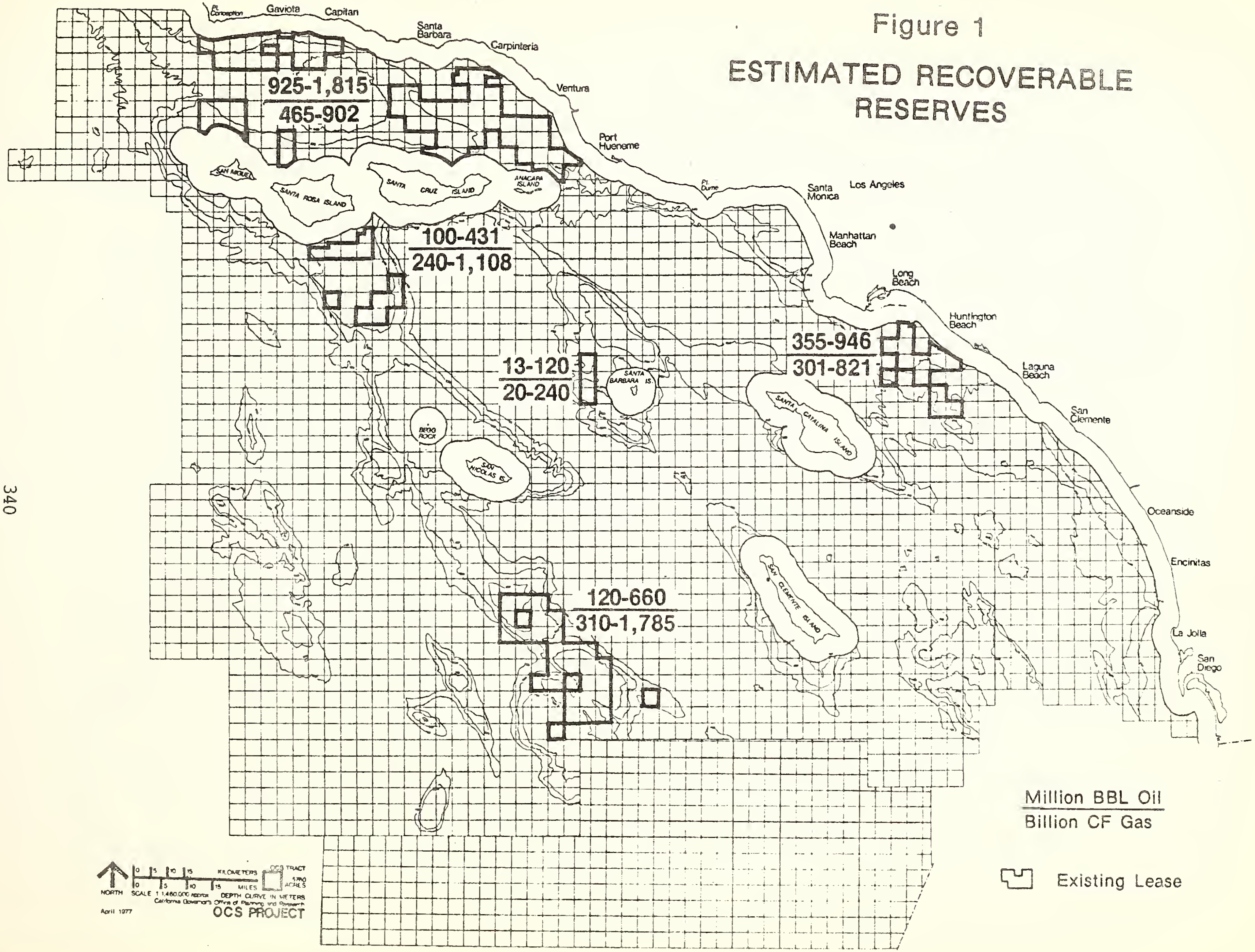
Most authorities estimate the in-place reserves in the southern California OCS as 3-5 billion barrels. They differ in their estimates of the percent recoverable of those reserves.

The importance of the Santa Barbara Channel area is due to two factors. The major proven reserves are located there and its proximity to shore makes it the most likely to be developed first. The San Pedro Bay area is the next candidate for development for the same reasons. Large fields may yet be discovered in deeper water, but the oil companies have traditionally developed in shallow waters first and moved steadily into deeper water.

The geology of the southern California OCS is significantly different from those previsouly developed by the oil industry. The Gulf coast, where the oil companies have had their greatest amount of OCS development experience, holds sandstone reservoirs; the southern California OCS has shale. Another major difference is the topography of the bottom. The Gulf has a smooth, gently sloping OCS, whereas, the southern California shelf consists of a series of submarine ridges that march in parallel north and south with deep ravines between. This feature will control the pattern of development that will take place on the southern California OCS. The ridge patterns will not only dictate which areas will be drilled first, but also the pattern of submarine

Figure 1

ESTIMATED RECOVERABLE RESERVES



pipelines that will carry crude oil to processing plants and refineries. Figure 2 shows the recommended offshore pipeline routes which march along the tops of submarine ridges.

These unique features of the southern California OCS lend themselves to development of an overall strategy or plan for the oil and gas development of the whole area. Such a plan will be difficult to develop and implement, however, because the same geology that makes a general plan so desirable complicates its development by creating a labyrinth of jurisdictional patterns. All of the offshore islands are technically part of the State of California. However, California shares management of these islands with the Navy, the U.S. Fish and Wildlife, and the National Park Services. Some of the islands are inhabited by small resort communities that share the conservation and environmental concerns of the 14 jurisdictions along the coast of the southern California OCS. In California, counties have a lot more autonomy than in other states.

Disputes among these parties can be expected since many jurisdictions overlap and events in one jurisdiction can affect events in another. Coordination among the parties that manage these jurisdictions will be complicated by existing disparity in the distribution of costs and benefits among the parties involved. Also, each party has a different set of values for the effects that can be anticipated from oil and gas development of the southern California OCS. For instance, an oil spill must be viewed as a regrettable expense by the industry and it will prevent them as best technology allows because they are expensive and cause delays. A resort owner on the beach of one of these islands sees an oil spill as a season of lost revenue and long court suits. The resort owner will be likely to put a much higher value on that oil spill than the industry. Figure 3 is a potential oil spill trajectory map prepared by the Office of Planning and

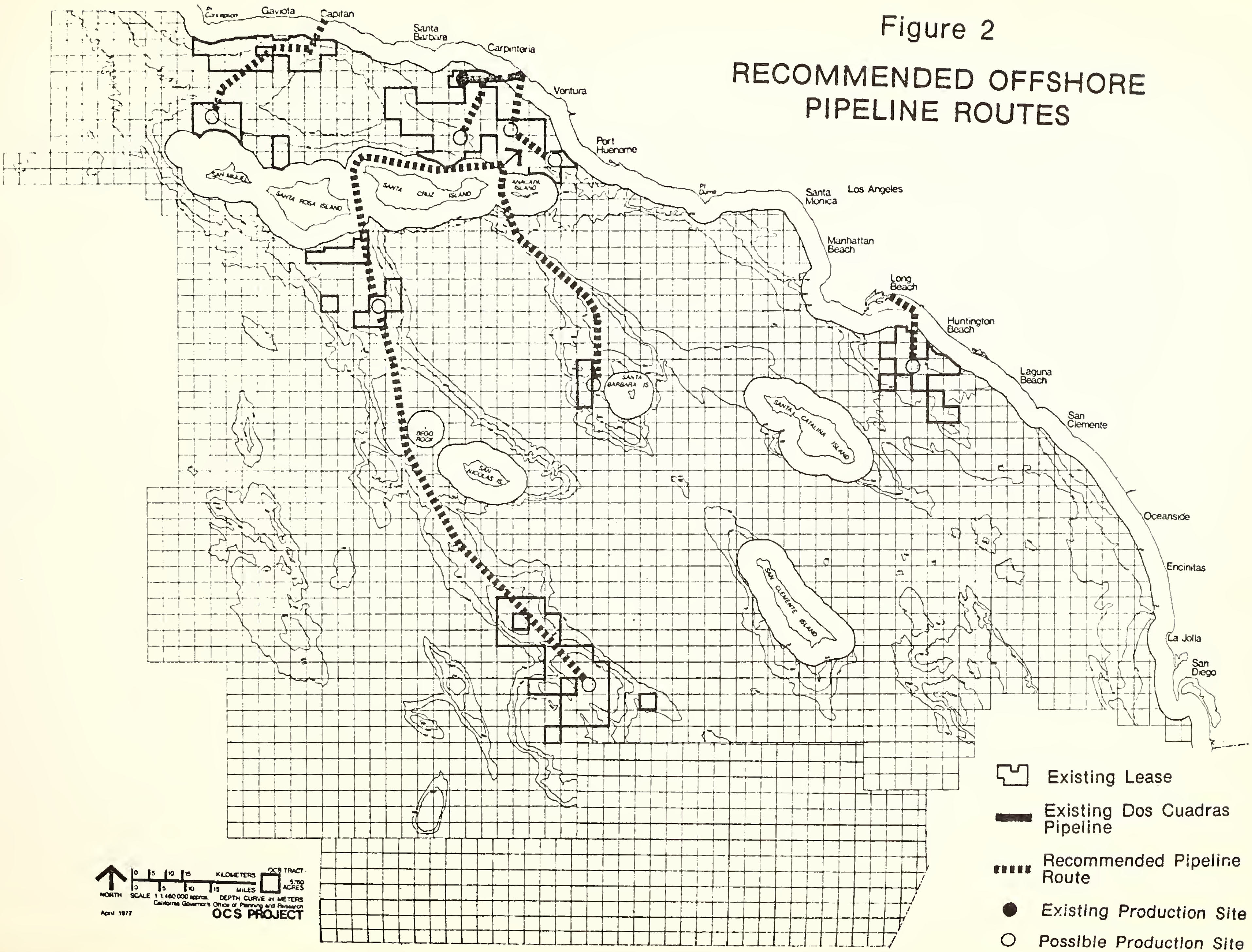


Figure 2

RECOMMENDED OFFSHORE PIPELINE ROUTES

Research (OPR), of the State of California. Since oil spills are controlled by winds, this map will give some idea of both air and water pollution potential in the area.

Chart 1 lists the broad effects that will result from oil and gas development on the OCS. The columns to the right of that list give some idea of the values assigned to those effects by the national government, by the State of California, by local California communities, and by the industry. The causes for disagreement among the various levels of government is predictable from this chart by the distribution of costs and benefits displayed here. The national government sees a large source of revenue in the bonuses and royalties it receives and an aid to its balance of payments problem. A lower dependence on imported oil also enhances national security.

The disparity in the effects accruing to the various levels of government is substantial as is demonstrated by the columns in Chart I which also indicate the potential for intragovernmental friction. State and local governments see small benefits compared to large costs. When the state and local governments lost the battle for ownership of the OCS in the 1950's, they lost the financial incentive that now stimulates the national government to develop the oil and gas resources of the OCS.

The attitude of each is affected by the sum of benefits and costs appearing in their column. Big benefits suggest an enthusiastic "yes" decision. If, however, the column total sums to a big negative, the party can be expected to oppose the decision with the same enthusiasm. In a trade-off situation some of the benefits accrued to one party can be shifted to the party with the negative total until both show a net benefit. Such a trade-off policy is one way that agreement among the various governmental levels can be achieved.

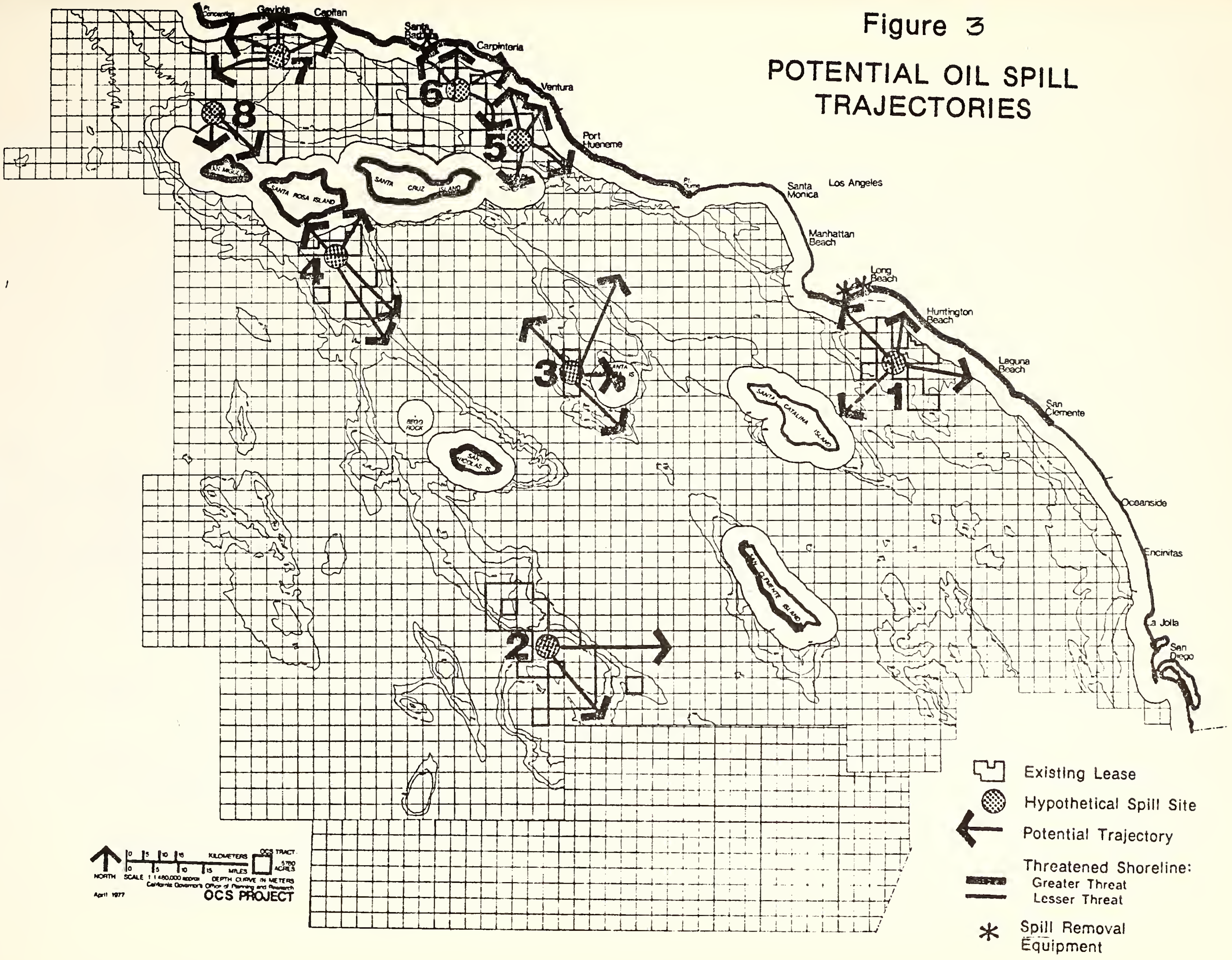
CHART 1

SOUTHERN CALIFORNIA OCS LEASE DECISION

EFFECTS	GOVERNMENT			INDUSTRY
	Nat'l	Calif.	Local	
Economic:				
Revenues	Bonus Royalty	Grant	Grant Taxes	
Consumer Surplus	+	neg.	neg.	
Producer Surplus				profits
Balance of Payments	+	+	+	
Employment	+	+	++	
Secure Reserves	Proj.Ind.neg.			
Clean Air Act		neg.	neg.	
Air Emissions:				
Public Health	(EPA)	neg.	neg.	
Envir.Damages	"	neg.	neg.	
Aesthetics	"	neg.	neg.	
Recreation	(Fish & Wild.)	neg.	neg.	ex. equip.
Tourism		neg.	neg.	ex. reqs.
Lost Opportunity		neg.	neg.	Courts, delays
Oil Spill:				
Same as Air Em.		neg.	neg.	
Marine Sanctuary	(NOAA)	neg.	neg.	
Marine Traffic:				
Pipelines	(Army Corps)	neg.	neg.	
Tankers	(C.Guard)	neg.	neg.	
Platform	(USGS)	neg.	neg.	
Decision	Yes	No		

Figure 3

POTENTIAL OIL SPILL TRAJECTORIES

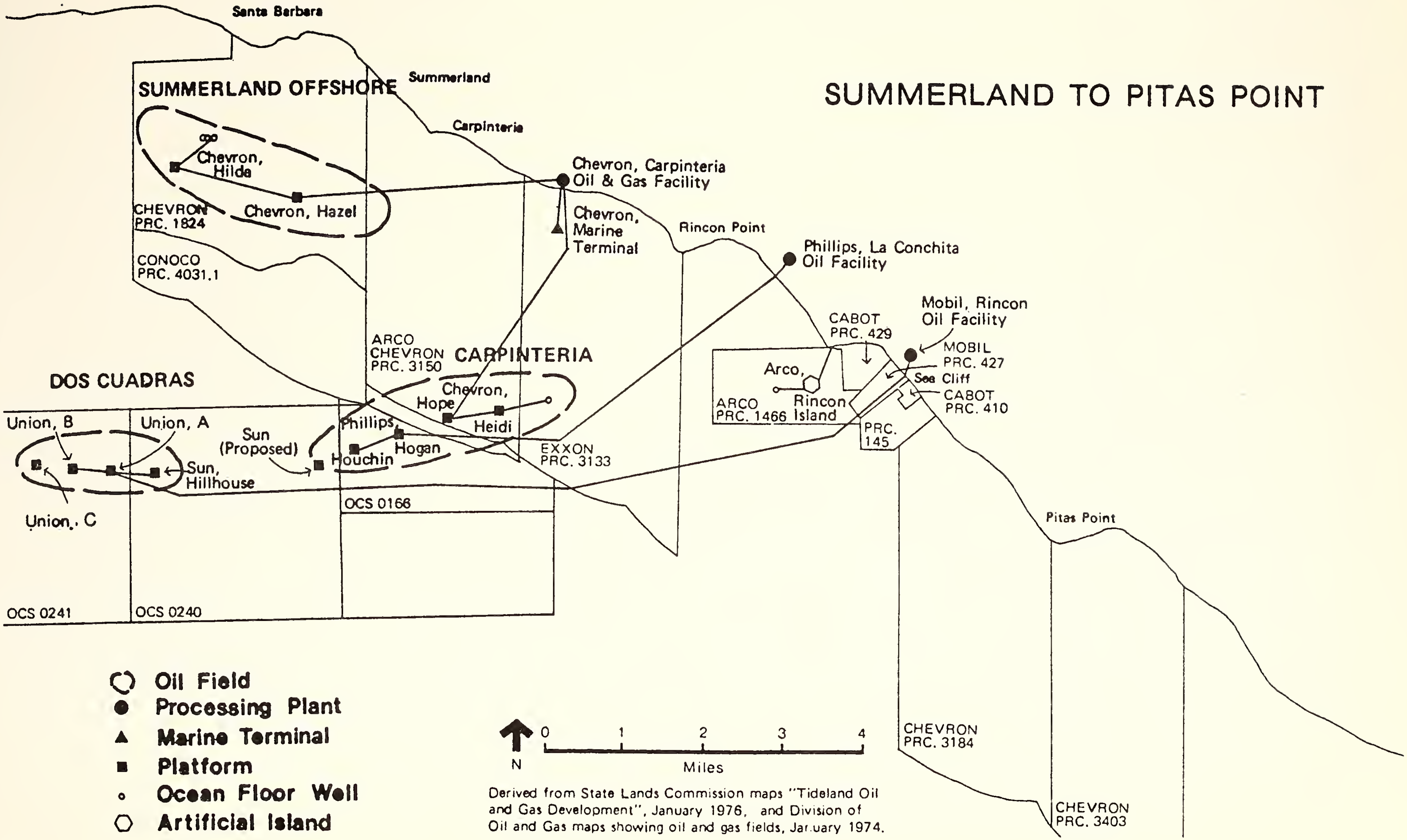


In Chart I each regulatory body is identified in the National Government column next to the effect that it is responsible to regulate. The Treasury Department and the Department of Interior are likely to see oil and gas development on the OCS in a different manner than EPA and Army Corps of Engineers. The first group sees large benefits and solutions to their problems in such benefits. The second groups may see only additional difficulties. Each regulatory body should, however, see that costs are balanced by a benefit of comparable quality and quantity. Instituting such a policy can be an effective means of reaching practical solutions in the decision process. A major stumbling block in finding such solutions is the variety of standards used by the various agencies in the exercise of their regulatory functions. Establishing uniform standards will be necessary in order to facilitate decision making in such protracted issues as OCS oil and gas development.

The effects of development should be tied to the major decisions controlling development events in a unified and coordinated manner, so that regulatory bodies can balance costs and benefits among the parties. The trade-off approach to policy making, if instituted by all regulatory parties could help insure that all effected parties become net gainers from the development. One way to accomplish this is to develop an overall plan and tie it to the major decisions made during development through decision analysis. A gross simplification of this process is displayed in Chart 2 where the effects listed in an earlier figure are tied to the lease decision.

What follows in this chapter is a case study of the OCS oil and gas development off the southern California coast. It relates the history of events which have produced the labyrinth of jurisdictional and regulatory authority that exists today over the OCS. Special emphasis is devoted to

SUMMERLAND TO PITAS POINT



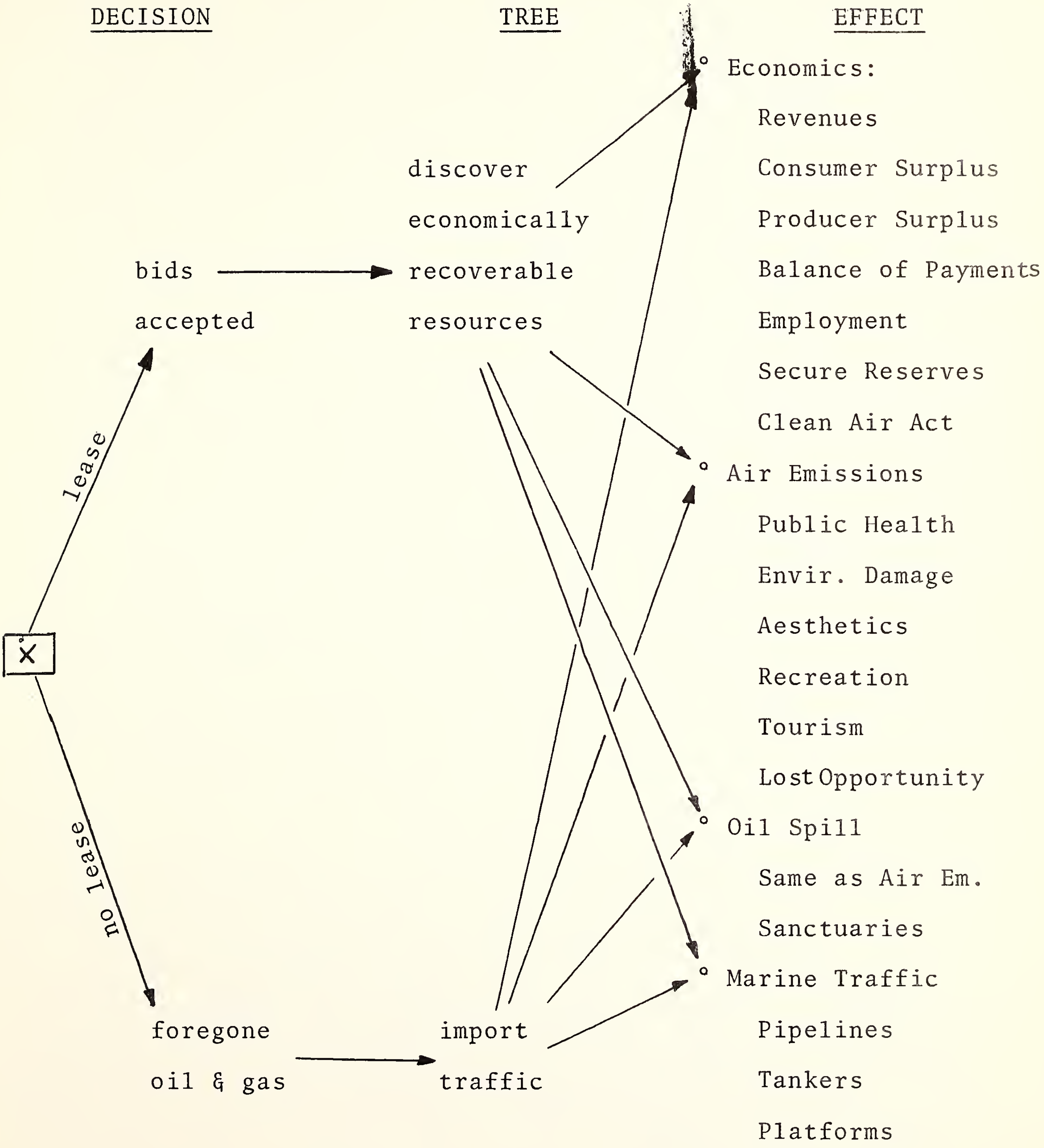
Derived from State Lands Commission maps "Tideland Oil and Gas Development", January 1976, and Division of Oil and Gas maps showing oil and gas fields, January 1974.

the Santa Ynez Unit, because of the precedent-setting nature of its history.

That development follows on the heels of the original OCS development off southern California in Carpintaria and Dos Cuadras fields. (See Chart 3.) Here the disasterous Santa Barbara oil spill of 1969 occurred. It halted all development temporarily and sensitized the various parties involved in its regulation and development to the importance of the stakes involved.

CHART 2

SOUTHERN CALIFORNIA OCS LEASE DECISION



B. Ownership of the OCS.

The Continental Shelf is the area seaward of low tide level that is submerged, but geologically part of the continent. A simple idea of a shallow shelf area breaking off to a slope down to the abyssal plain is not adequate for California's geology. The fault lines and rows of mountains that characterize the coastal geology of California north of Point Conception run out to the sea south of there and form the Channel islands and shoals. State jurisdiction extends seaward from the low tide level of any coast line for three miles. Beyond that "to a depth of 200 meters or, beyond that limit to where the depth of the superadjacent water admits to the exploitation of the natural resources of the said area," (Adams, 1972) is the Outer Continental Shelf, (OCS), and federal jurisdiction.

The pace of the county-state-federal jurisdictional dispute over the OCS in southern California has been controlled by the economics of the oil industry and the technology that has resulted. The attraction of potential revenue that oil and gas development can provide, originally in the form of bonuses and royalties and later in the tax base of the oil industry, has been the focus of government jurisdictional disputes.

The county's battle with the State of California for submerged oil rights started as oil fields were discovered offshore. State leasing started when it was found that the counties could drain a field from shore using slant drilling from land fill islands. The encroachment of counties into state submerged lands was settled in 1958 when the industry found it cheaper to build platforms rather than land fill islands.

The earliest offshore oil production in the United States was developed off Summerland, (Santa Barbara County) California in 1896. The offshore portion of the field was an extension of an onshore discovery that had been made prior to 1894. The offshore wells were drilled from wooden piers extending out from the shoreline. In all, more than 400 shallow wells were drilled and completed at a depth of about 600 feet. At that time, the State of California had no authority to lease tideland areas, so these wells were drilled under leases obtained from the littoral land owners.

Shortly thereafter the counties claimed the rights to mineral leases. So, the first skirmishes over property and mineral rights for offshore oil and gas was between the state and the county. In 1921, the California legislature passed the Mineral Leasing Act which gave the state permitting power over the exploration of oil and gas.

California is a "nation within a nation," however, and this tradition was borne out in a series of California Supreme Court decisions beginning in 1928 when it rejected the state's permitting rights and finally settled the dispute in favor of the county on dry land to low tide and gave the right to submerged lands to the state. Coincidentally, some major fields were discovered -- Rincon in 1927, Elwood and Capitan fields in 1929, and Wilmington field in 1932. Long Beach wasted no time (January, 1929) in developing its fields. County jurisdiction was extended in 1954 by drilling on "fill land" (Belmont Island) and again in 1958 with Rincon Island.

After the 1938 California Supreme Court decision, the California Legislature created the State Lands Commission (1939) to handle the leasing of submerged lands being drained from land wells by county leasing. A jurisdictional dispute then arose between California and the federal government which was decided in 1947 by the U.S. Supreme Court in favor of the federal government. However, since the OCS jurisdictional dispute had not been settled on the national scale, an interim agreement gave temporary jurisdiction to the State Lands Commission out to 3 miles. The Submerged Lands Act of 1953 made this jurisdiction permanent.

On September 28, 1945 President Truman issued Proclamation 2667, upheld by the Supreme Court in 1947, which states that "the Government of the United States regards the natural resources of the subsoil and seabed of the continental shelf beneath the high seas but contiguous to the coasts of the United States as appertaining to the United States, subject to its jurisdiction and control." Although the oil industry had been moving offshore for nearly half a century, this proclamation essentially arrested further development.

The Submerged Lands Act of May 22, 1953 (67 Stat. 29; 43 U.S.C. 1301-1315) returned to all the coastal states a belt of submerged lands seaward of their coast lines to a distance of 3 geographical miles and extended to each the opportunity to prove entitlement in judicial proceedings to a greater grant, up to 3 marine leagues (9 geographical miles), through proof that it had in its charter a boundary extending more than 3 miles from its coast when it came into the Union, or such an extended boundary had been approved by Congress prior to enactment of the Submerged Lands Act. The Act preserved federal ownership and control of the subsoil and sea bed of the submerged lands lying seaward of the belt granted the coastal states.

The Outer Continental Shelf Lands Act of August 7, 1953 (67 Stat. 462; 43 U.S.C. 1331-1343) reaffirmed that "those lands beyond the 3 geographical mile limit, or more, appertain to and are subject to the jurisdiction, control and power of disposition of the Federal Government." It authorized the Secretary of the Interior to grant mineral leases to Outer Continental Shelf lands and to prescribe such regulations as might be necessary to carry out the provisions of the Act. With respect to oil, gas, sulfur, and other mineral operations on the Outer Continental Shelf, the Secretary has promulgated the regulations contained in Part 250 of Title 30 of the Code of Federal Regulations. These regulations are implemented and enforced by the U.S. Geological Survey.

Under the provisions of the Outer Continental Shelf Lands Act, the subsoil and the seabed underlying these ocean waters belong to the United States and are subject to its jurisdiction and control. The Act specifically excludes the high seas of the waters above the Outer Continental Shelf particularly with respect to the rights to navigation and fishing. However, exploitation of the resources must be conducted in a manner that will result in a minimum of disruption to the waters overlying the Outer Continental Shelf, the navigable waters within the seaward boundary of the adjacent state, and the public and private property located on the adjoining mainland (Adams, 1972).

The 1958 Geneva Convention on the Continental Shelf, which the United States ratified in 1961, defines the seaward limits of the continental shelf as out "to a depth of 200 meters or, beyond that limit, to where the depth of the superadjacent waters admits to the exploration of the natural resources of the said areas..." However, this definition of seaward limits is not precise, nor has a precise definition been developed at subsequent conventions on the law of the sea.

California,having lost the principal jurisdictional battle to the federal government, continued to battle for jurisdiction over the area between the Channel Islands and the California coast. This dispute was settled in the U.S. Supreme Court decision of 1965 when the state was awarded 3 miles around the low tide mark of the Channel Islands. An extension of the state jurisdiction was awarded by the same court in 1978 when 3 shoal areas were added to the island count.

C. Development of the OCS.

The Bureau of Land Management leased tracts off the coasts of Washington, Oregon and California north of Point Conception in 1963. No economically recoverable oil reserves were found. That left the area in the OCS south of Point Conception the site of the only major West Coast proven reserves in the continuous United States.

The state has leased submerged lands under its jurisdection as demand and technology permitted and in 1966, California leased the state lands over Carpinteria, a field which extends into federal territory. The federal response was predictable. In 1967, the Bureau of Land Management held a lease sale for the federal section of that field.

In the following year, the federal government conducted another lease sale and let 71 leases in the Santa Barbara Channel. The following table shows the amount of revenues that have been generated by OCS lease sales up to 1973.

Table 1 - Outer Continental Shelf Lease Sales by years, states, minerals (Harris, W.M., Piper, S.K., and McFarlane, B.E., 1974)

Date of Sale	Mineral	No. of Leases	Acreage	Bonus	1st year rent
12-15-61	Phosphate	6	30,240	$ 122,000	$ 15,120
5-12-65	(refunded everything)				
5-14-63	Oil & gas	57	312,945	12,807,587	938,838
12-15-66	" "	1	1,995	21,189,000	9,980
2-06-68	" "	71	363,181	602,719,262	1,089,543
TOTAL AS OF 1973		129	678,121	$636,715,849	$2,038,361
Producing as of 1973, December		17	82,576		
Nonproducing " "		52	269,301		

The total revenue to the United States Treasury through 1973 has amounted to 80 percent of the total production value of all products from Outer Continental Shelf lands.

All oil and gas leases on the Outer Continental Shelf issued through 1973 required a royalty rate of 16-2/3 percent of the amount or value of production from the lease. The annual rental or minimum royalty required for leases in unproven areas has been $3.00 per acre. In the cases of leases in proven areas, (like the San Pedro Bay Unit) the annual rental or minimum royalty has generally been $10.00 per acre. Although the dollar amount of rental or minimum royalty is the same, rental is paid at the beginning of the lease year on lands that have not been proven productive; whereas minimum royalty is paid at the end of the lease year on lands that have been determined by the Geological Survey to be capable of producing oil and gas in paying quantities.

Table 2. Cumulative bonuses, minimum royalties for California OCS August 7, 1954 to December 31, 1973.

Bonuses	$636,715,849
Min. Royalties	201,695
Rentals	8,883,564
Royalties	58,561,372
Total	$704,362,480

Revenue from the OCS is a major source of financing for the Land and Water Conservation Fund. The fund is the largest federal grant-in-aid program of assistance to states, counties, and cities for the acquisition and development of public parks, open spaces, and recreation lands and water. In addition, the fund pays acquisition costs for authorized areas being added to the national system of parks, forests, wild life refuges, wild and scenic rivers, and scenic and recreational trails.

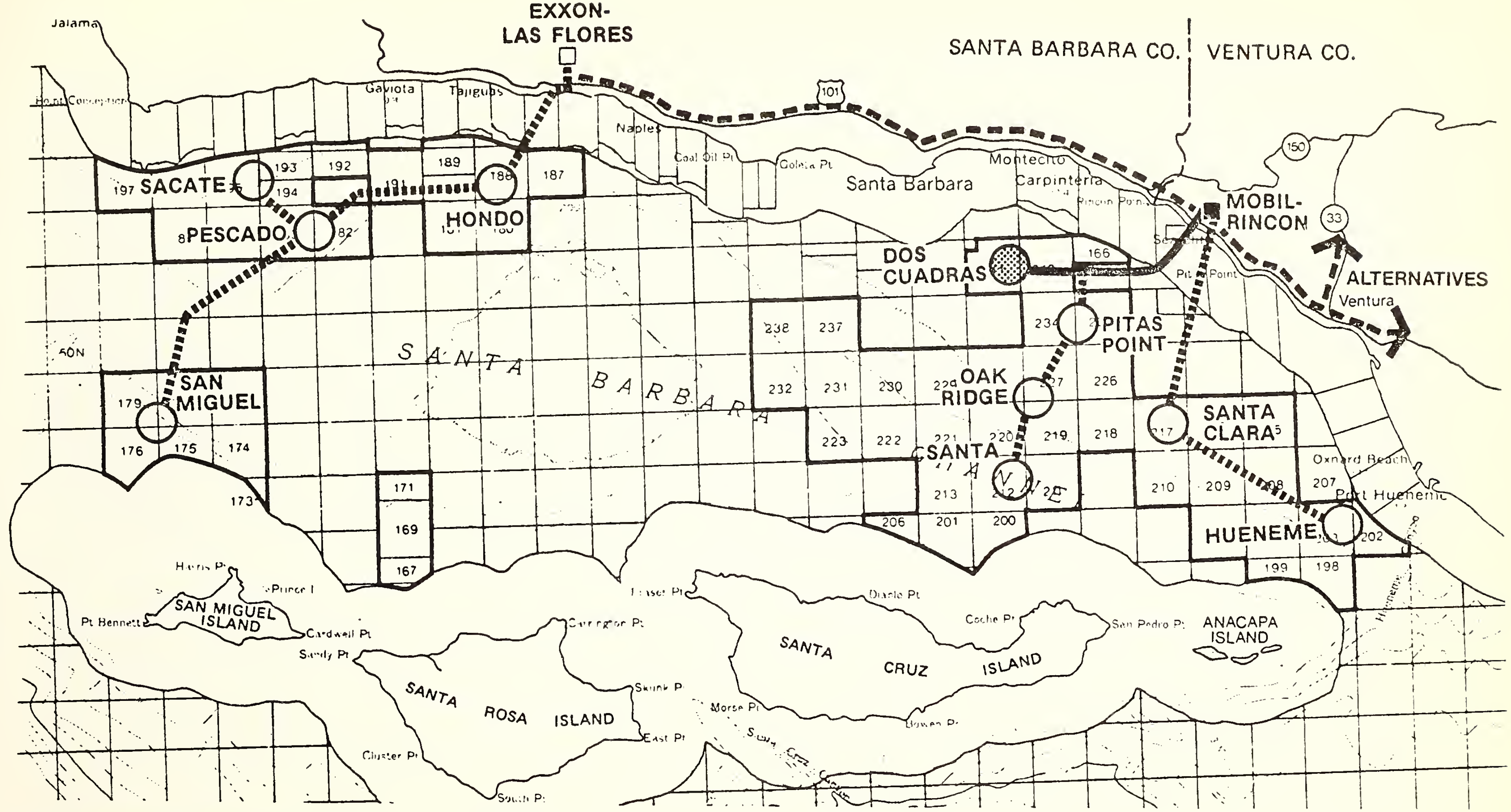
Table 3. Land and Water Conservation Fund moneys to California as of June 30, 1974 were:

Type	No.	Amount
Planning	4	$ 607,116.74
Acquisition	123	45,495,272.32
Development	186	23,658,245.75

The fund, which is administered by the Bureau of Outdoor Recreation in the Department of the Interior, was established by Congress in 1964. (Pub. L.88-578, September 3, 1964, Stat. 897). Amendments to the original legislation provided that the annual income of the fund be not less than $200,000,000 for the fiscal years of 1968, 1969, and 1970, and $300,000,000 for the fiscal years of 1971 through 1989. California's share of that fund as of June 30, 1974 is shown in Table 3. (USGS Cir. 720).

In August 1974, the Department of the Interior - as part of an accelerated national strategy to reduce dependence on foreign oil - announced that 297 tracts totaling approximately 1.7 million acres of federal OCS lands off the southern California coast, would be opened for production of oil and gas. Subsequently, in December 1974, the U.S. Department of the Interior concluded southern California Lease Sale 35 by accepting bids for 56 of the 221 tracts actually offered. (See Figure 4.)

The U.S. Department of the Interior issued a Call for Nominations for OCS Lease Sale 48 on July 16, 1976. The OCS Lease Sale 48 area (see Figure 5) encompasses the area offshore of southern California covered by Lease Sale 35, except Santa Monica Bay, and all unleased tracts in the Santa Barbara Channel except the Ecological Preserve and Federal Buffer Zone. Also excluded from Lease Sale 48 are a few tracts along the disputed California-Mexico offshore boundary and tracts adjacent to state lands where a potential



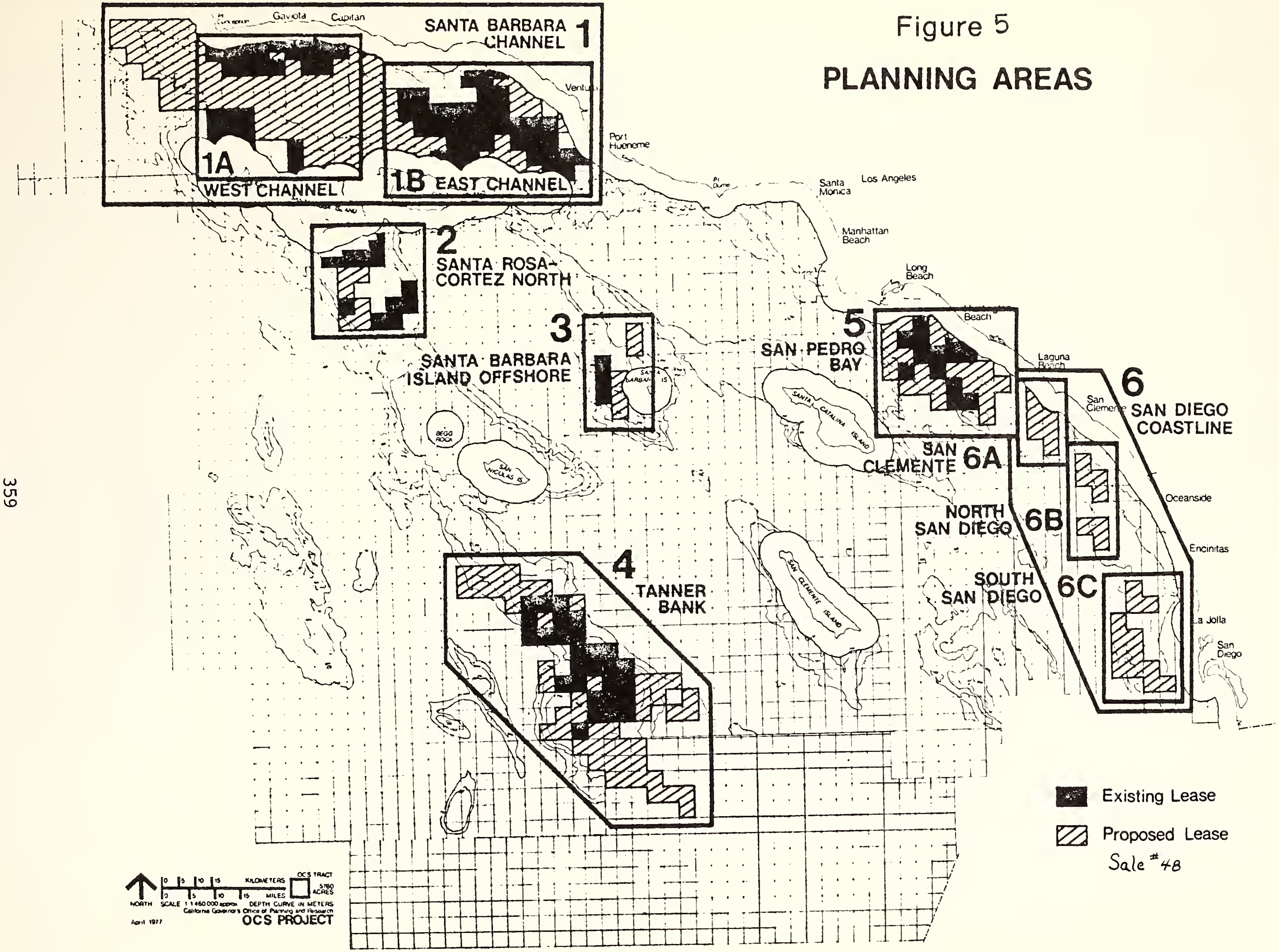
RECOMMENDED PIPELINE ROUTES:
SANTA BARBARA CHANNEL

Figure 4

Leased Area
Recommended Offshore Pipeline Route
Recommended Onshore Pipeline Route
Existing Dos Cuadras Pipeline
■ Existing Mobil Processing Plant
□ Proposed Exxon Processing Plant
⊗ Existing Production Site
○ Possible Production Site
NORTH
April 1977
0 3 5 10 KILOMETERS
0 3 5 10 MILES
SCALE 1:500,000 DEPTH CURVE in FATHOMS
OCS Tract
5760 ACRES
California Governor's Office of Planning and Research
OCS PROJECT

Figure 5

PLANNING AREAS



for drainage of state tracts exists.

Included in the Call for Nominations for Lease Sale 48 were 2,400 tracts, totaling over 13.2 million acres. Industry response to the call indicated an interest in 970 tracts, involving over 5 million acres. Areas of highest interest to industry are the Santa Barbara Channel, San Pedro Bay, and offshore San Diego County. State and local governments responded to the Call for Nominations by recommending that approximately 650 tracts, totaling 3.6 million acres, be excluded from the sale.

Negatively nominated tracts included those within the Santa Barbara Channel, San Pedro Bay to Santa Catalina Island (both areas covered by shipping lanes) and all tracts located within three miles of the state/federal offshore boundary along the southern California coast and around all islands. (California State Energy Commission, 1977). Department of the Interior schedules call for lease sale tract announcements in August 1978, with Lease Sale 48 to be held in October 1978. In addition to Lease Sale 48, the Department of the Interior is also planning to conduct Lease Sale 53, off central and northern California. The many delays that have set back Lease Sale 48 make it difficult to predict when Lease Sale 53 will take place.

D. The Santa Ynez Controversy.

The Santa Ynez Unit is a group of 17 federal lease tracts in the western end of the Santa Barbara Channel between Point Conception and Capitan, immediately adjacent to the three-mile seaward limit of California's territorial jurisdiction. (See Figure 4.) These leases were part of Lease Sale No. 35, in which Exxon bid $94,000,000 for its Santa Ynez Unit tracts and $218,000,000 for all the tracts it acquired in the Santa Barbara Channel. The Santa Ynez Unit received USGS approval November 12, 1970 with Exxon, USA, as unit operator.

The U.S. Geological Survey and Exxon estimate oil in place in the unit at 3-5 billion barrels. USGS, using a recovery factor of 22-24%, has estimated that 730-1100 MMB (million barrels) oil could be produced from this unit. The Oil and Gas Journal (January 31, 1978) estimates that 1,000 MMB oil might be recovered from this unit. Exxon's own estimates, using a 10-15% recovery factor, is that 400-500 MMB oil could ultimately be produced. The USGS has predicted natural gas estimates at GOR (gas produced in millions of cubic feet) of 500, while Exxon expects a production GOR of 2500, with a residual (gas for sale at market) GOR of about 1500. On the basis of USGS estimates, Santa Ynez recoverable reserves constitute 40-65 percent of the remaining Santa Barbara Channel recoverable petroleum reserves.

Figure 6 shows the production scenario expected from the Santa Ynez Unit by Exxon, based on its estimates of ultimate recovery of 419 MMB oil projected by the OCS task force of OPR (Office of Planning Research) in 1977. "Hondo 1" is the platform called for in Exxon's initial plan. It was installed in 1976 and started production in the second quarter of 1978. Exxon's production from this first platform is to peak at 25,000 to 30,000 B/D (barrels per day) of oil

FIGURE 6
SANTA YNEZ PRODUCTION SCENARIOS

(Case 1: Derived from Exxon Statements)

	Hondo$_1$		Hondo$_{2,3}$		Total Hondo		Sacate and Pescado		Total Santa Ynez Unit	
Year	Oil (B/D)	Gas (MCF/D)	Oil (B/D)	Gas (MCF/D)	Oil (B/D)	Gas (MCF/D)	Oil (B/D)	Gas (MCF/D)	Oil (B/D)	Gas (MCF/D)
1978	16,000	24,000			16,000	24,000			16,000	24,000
1979	27,000	40,500			27,000	40,500			27,000	40,500
1980	30,000	45,000			30,000	45,000			30,000	45,000
1981	30,000	45,000			30,000	45,000			30,000	45,000
1982	30,000	45,000	10,000	15,000	40,000	60,000			40,000	60,000
1983	30,000	45,000	20,000	30,000	50,000	75,000	8,000	12,000	58,000	87,000
1984	22,500	33,800	35,000	52,500	57,500	86,200	15,000	22,500	72,500	108,800
1985	16,900	25,400	43,000	64,500	59,900	89,800	20,000	30,000	79,900	119,800
1986	12,700	19,000	43,000	64,500	55,700	83,600	25,000	37,500	80,700	121,000
1987	9,500	14,200	43,000	64,500	52,500	78,800	25,000	37,500	77,500	116,200
1988	7,100	10,600	43,000	64,500	50,100	75,200	30,000	45,000	80,100	120,200
1989	5,300	8,000	43,000	64,500	48,300	72,400	35,000	52,500	83,300	125,000
1990	4,300	6,300	32,200	48,300	36,400	54,600	40,000	60,000	76,400	114,600
1991	3,400	5,100	24,200	36,300	27,600	41,400	40,000	60,000	67,600	101,400
1992	2,700	4,000	18,100	27,200	20,800	31,200	40,000	60,000	60,800	91,200
1993	2,200	3,300	13,600	20,400	15,800	23,700	40,000	60,000	55,800	83,700
1994	1,700	2,600	10,200	15,300	11,900	17,800	32,000	48,000	43,900	65,800
1995	1,400	2,100	7,700	11,600	9,100	13,600	25,600	38,400	34,700	52,000
1996	1,100	1,500	6,100	9,200	7,100	10,600	20,500	30,800	27,600	41,400
1997	900	1,200	4,900	7,400	5,700	6,600	16,400	24,600	22,100	33,200
1998	93MMB	140BCF	3,900	5,800	3,900	5,800	13,100	19,600	17,000	25,500
1999			3,100	4,600	3,100	4,600	11,100	16,600	14,200	21,300
2000			2,500	3,800	2,500	3,800	9,500	14,200	12,000	18,000
2001			2,000	3,000	2,000	3,000	8,000	12,000	10,000	15,000
2002			1,600	2,400	1,600	2,400	6,800	10,200	8,400	12,600
2003			150MMB	225BCF	243MMB	365BCF	5,800	8,700	5,800	8,700
2004							4,900	7,400	4,900	7,400
2005							4,200	6,300	4,200	6,300
2006							3,600	5,400	3,600	5,400
2007							3,000	4,500	3,000	4,500
							176MMB	264BCF	419MMB	628BCF

FIGURE 7

ALTERNATIVE SANTA YNEZ UNIT PRODUCTION SCENARIOS

Year	CASE 2 Oil (B/D)	CASE 3 Oil (B/D)	CASE 4 Oil (B/D)	CASE 5 Oil (B/D)
1978	16,000	16,000	16,000	16,000
1979	27,000	27,000	27,000	27,000
1980	30,000	30,000	40,000	30,000
1981	40,000	40,000	60,000	30,000
1982	60,000	60,000	80,000	40,000
1983	90,000	90,000	80,000	58,000
1984	120,000	120,000	80,000	72,500
1985	140,000	140,000	80,000	90,000
1986	180,000	180,000	80,000	120,000
1987	200,000	200,000	80,000	140,000
1988	200,000	250,000	80,000	140,000
1989	200,000	300,000	80,000	140,000
1990	150,000	300,000	80,000	140,000
1991	112,000	300,000	80,000	140,000
1992	84,000	225,000	80,000	134,000
1993	68,000	169,000	80,000	118,000
1994	54,000	127,000	80,000	106,000
1995	43,000	95,000	80,000	99,000
1996	35,000	71,000	80,000	77,000
1997	28,000	57,000	80,000	61,000
1998	24,000	46,000	80,000	49,000
1999	20,000	36,000	80,000	40,000
2000	17,000	29,000	80,000	31,000
2001	14,000	23,000	80,000	26,000
2002	12,000	20,000	80,000	22,000
2003	10,000	17,000	80,000	19,000
2004	9,000	14,000	48,000	16,000
2005	8,000	12,000	29,000	9,000
2006	6,000	10,000	17,000	7,000
2007	5,000	9,000	10,000	6,000
	730MMB	1100MMB	730MMB	730MMB

in the early 1980's with ultimate recovery of 94 MMB oil in 20 years. After peak, a 25% decline rate is assumed for six years, 20% thereafter. "Hondo 2" and "Hondo 3" represent the complete development of the Hondo field based on Exxon's estimates using two additional production platforms. This scenario assumes a peak flow from the total Hondo field of 60,000 B/D oil and ultimate recovery of 243 MMB oil in 30 years. Exxon has not published reserve estimates or production forecasts for the other 2 fields discovered in the Santa Ynez Unit, Sacate or Pescado. However, using Exxon's predictions for both Hondo and the whole unit, California's OCS Task Force of OPR constructed a production scenario for the various parts of the Unit. See Figure 6 for Case 1 scenario.

Several alternative scenarios were constructed by OPR to illustrate production if any of the higher reserve estimates proved to be fact. See Fig. 7. Case 2 uses the same 30-year producing lifetime for the unit as Case 1, but assumes that 730 MMB oil are recovered. Case 3 assumes 1100 MMB oil are recovered. The last two scenarios describe other ways in which 730 MMB oil could be recovered within 30 years. In case 4, unit oil production is not permitted to rise above 80,000 B/D. In case 5, production is permitted to rise above 80,000 B/D, but not as high as case 2. Both cases assume 730 MMB oil reserves are discovered early in the unit's production lifetime just as in case 2. Figures 6 and 7 are provided to give an order of magnitude feel for possible Santa Ynez unit production which serves as the multiplier factor for the effects that will result.

Part of the uncertainty surrounding the Santa Ynez Unit reserve estimates stems from the fact that unit exploration is not yet complete. The Hondo field was discovered July 13, 1969. Twenty-four of the 32 wells drilled by the end of 1977 in the Unit were drilled in the vicinity of the Hondo field. Exxon has defined the potential of the Hondo field to its satisfaction and has made public its potential reserves. Case 1, figure 6, is based on these estimates.

Pescade and Sacate fields were discovered in May and August, 1970. Exxon has not completed exploration of these discoveries and has not published estimates. Exxon plans 4 to 6 new exploratory wells in the vicinity of Sacate and Pescado by mid-1979. (OCS Task Force of OPR, 1977).

Another reason for uncertainty involves the main reservoir rock in the Unit: fractured Monterey shale. In contrast with the more common sandstone reservoirs, the production characteristics of Monterey shale are relatively unknown and difficult to predict. The porosity and permeability of Monterey shale are apparently too low to permit economic production from the shale itself. Only where rock is fractured in inter-connected mazes which allow oil to creep in over geologic time can economic production be achieved and sustained. The degree on inter-connection of the fractures is difficult to predict with any assurance before production begins. This difficulty is the basis of the difference between Exxon and the USGS.

One way for Exxon to increase its reserve in the Santa Ynez unit is to increase the percentage of oil-in-place it can recover. In sandstone formations this would involve secondary recovery methods such as water flooding or steam injection into the reservoir rock. The nature of Monterey shale make such enhanced production an uncertain proposition. Secondary recovery techniques have been applied to fractured shale oil fields in the Santa Maria basin in northern Santa Barbara County with little or no success. To boost its estimates of recoverable oil in the Santa Ynez Unit, Exxon must either find new reserves in the vicinity of the Sacate and Pescado fields or devise a production enhancement technique effective in fractured Monterey shale, or both.

Exxon plans to develop the Santa Ynez Unit in a series of steps. The first Hondo platform is in place and producing. If the first year's production results are encouraging, Exxon will develop the remainder of the Hondo field. By mid-1979, Exxon will have the results of new exploratory wells around Sacate and Pescado. If these test-well results and the production trends from the initial Hondo platform are favorable, Exxon will develop these fields.

As of June 1978, Exxon is producing from a single platform in 850 feet of water five miles from shore. Processing of the oil is handled on the deck of a tanker moored nearby, also outside California jurisdiction. The tanker serves as storage and terminal facility. The design capacity of this offshore facility is 60,000 B/D oil.

The natural gas produced on the Hondo platform will be used to fuel the operations of both the platform and the offshore oil processing and transfer unit. Exxon intends to reinject the natural gas it does not use to increase oil production. Whether and when any Santa Ynez Unit natural gas is available to consumers depends upon the utilization of an onshore gas processing facility. The existing Coastal Commission permit explicitly forbids bringing gas ashore.

The story of how the Santa Ynez Unit became the first totally offshore, oil and gas production, processing, storage and transfer facility in the U.S. is known as the Santa Ynez Controversy. The remainder of this chaper is the story of that controversy.

On January 15, 1971, Exxon submitted its preliminary plan of operation for the Santa Ynez Unit to U.S. Geological Survey. In 1973, Exxon submitted its final plan. The plan was approved August 16, 1974 by Acting Secretary of the Interior, John Whitaker. The plan described two possible scenarios for the developed of the Santa Ynez Unit. They are distinguished by the location at which the oil and gas separation, treatment, and storage take place and are referred to as the "onshore" and the "offshore" alternatives. Under both plans Exxon proposed to begin by erecting a drilling and production platform in water 850 feet deep over Hondo field approximately five miles from shore.

The onshore plan calls for the mixture of oil, water and gas produced at the platform to be transported by subsea pipeline to an oil and gas separation and treatment plan located in Los Flores Canyon, 1.5 miles from the coast. The design capacity of this facility would match the highest production rates anticipated from the Santa Ynez Unit, 80,000 barrels of oil per day and 90,000 cubic feet of gas per day. (See figure 8).

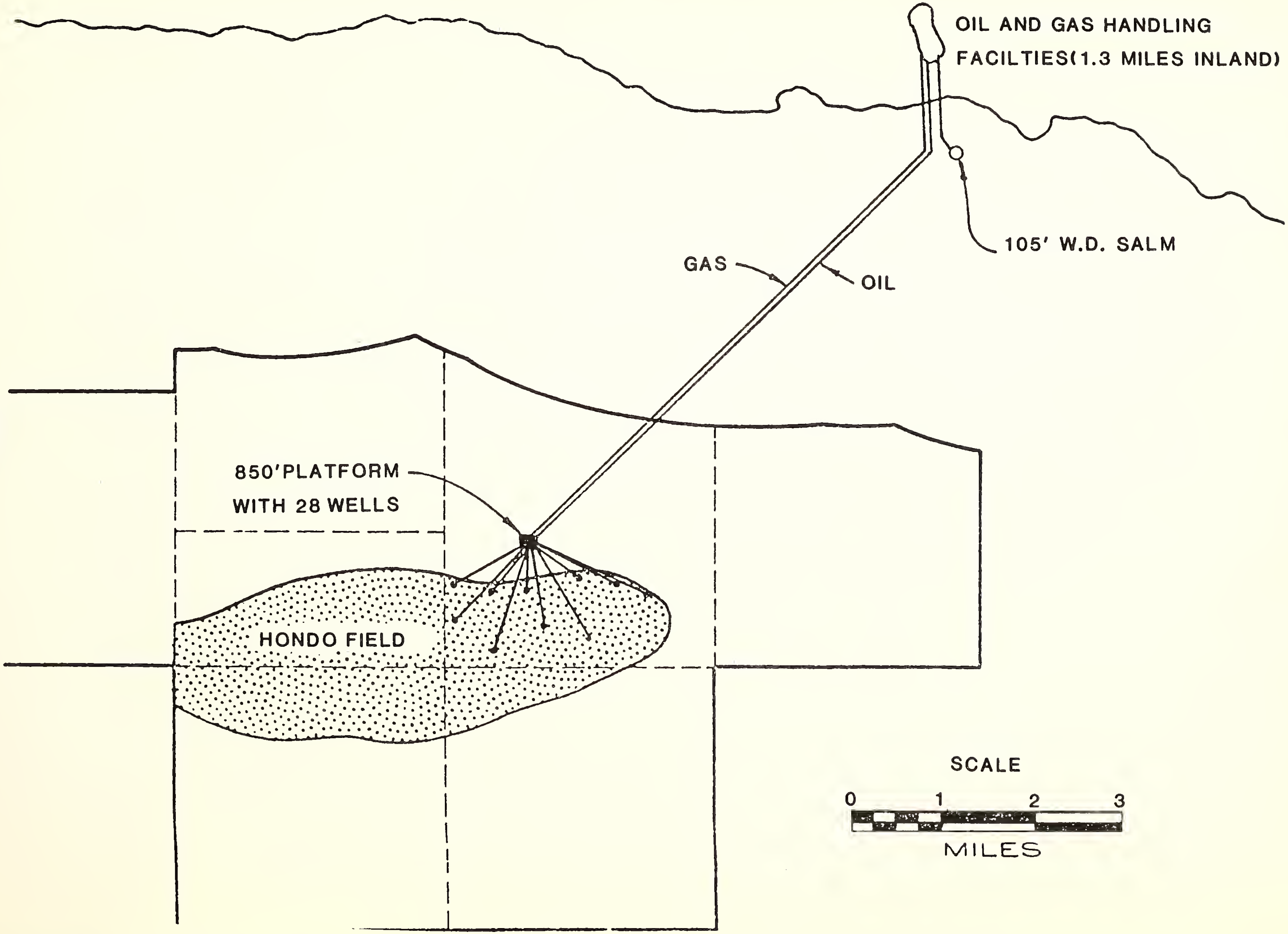
Exxon purchased 1500 acres of Corral and Los Flores Canyons in which are located Shell Oil Company's production and processing facilities for (onshore) Capital Field. Existing equipment at Los Flores includes a 2,000 barrel surge tank, a 2,000 barrel wash tank and a 2,000 barrel stock tank. The plant is designed to handle 8,000 B/D fluids with a net oil capacity of 800 B/D. This plant presently processes fluids from the Capitan field at the rate of 2950 B/D fluids and 215 B/D oil. Crude storage capacity is 10,750 barrels.

In Corral Canyon, Shell operates a tank battery and dehydration facility designed to handle 6000 B/D fluids and 1000 B/D oil. The present capacity of this plant is 1000 B/D fluids and 100 B/D oil from Capitan field. The combined surplus capacity of these two plants is presently 10,050 B/D fluids and 1485 B/D oil. Incidentally, Shell owns tract OCS-P-0185, one of the Santa Ynez Unit tracts.

Under the onshore plan, gas from Los Flores would be fed to nearby commercial pipelines for California consumption. The crude oil would be piped back to the coast to a tanker terminal 3,500 feet offshore. From there, tankers or barges

FIGURE 8

INITIAL DEVELOPMENT PLAN (ONSHORE) SANTA YNEZ UNIT



would carry the crude to refineries in Los Angeles and San Francisco. Exxon has purchased the Shell terminal that once served the Capitan field. This facility consists of 5 buoys and a crude storage capacity of 20,000 barrels and is fed by a 16-inch diameter pipeline.

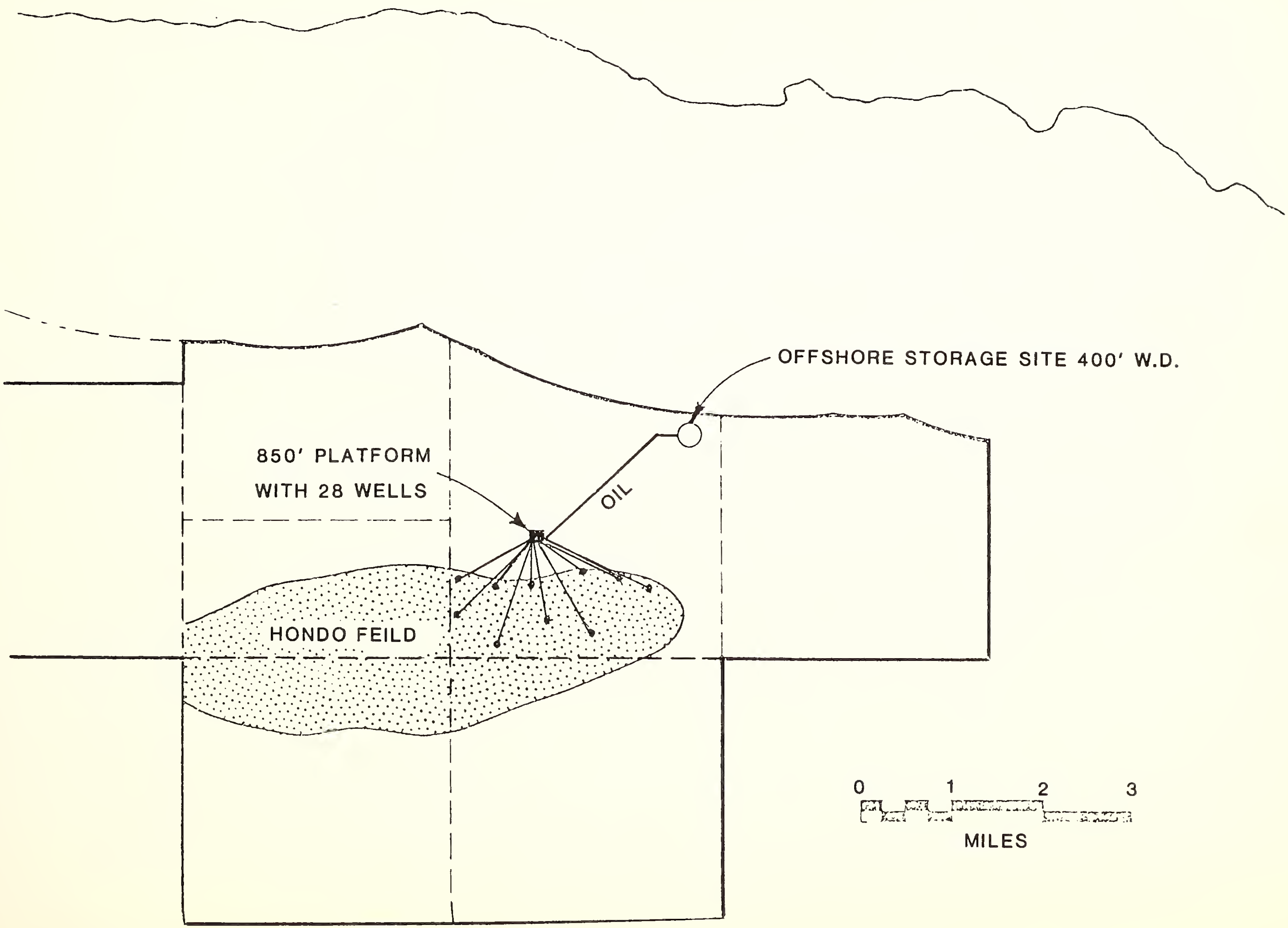
Exxon's development plan included an offshore alternative that would allow production, processing, storage and terminal facilities entirely in federal waters. This plan provides an alternative should state and local regulatory authorities either refuse permission for some aspect of the primary proposal or grant approval only under conditions Exxon considered oppressive. Under the offshore alternative, separation and treatment facilities would be stationed on the deck of a tanker moored 3.2 miles from shore. The tanker would also serve as storage and terminal facilities. The natural gas, which could not be transported to California markets without subjecting Exxon to state jurisdiction, would have to be reinjected into the reservoir. (See figure 9.)

In approving the Offshore Alternative, Mr. Whitaker cautioned that his approval could be withdrawn if he were to determine that Exxon had not made "diligent, good faith efforts to obtain permission from the appropriate state agencies to construct and operate the onshore facility under reasonable terms and conditions." (OCS Task Force of OPR, 1977.)

On August 7, 1973, Exxon filed an application with the Federal Power Commission (FPC) for a Certificate of Public Convenience and Necessity for a pipeline to carry gas ashore from the Hondo production platform. Oil pipelines are not subject to FPC jurisdiction. In their application, Exxon proposed to construct both oil and gas lines simultaneously, to minimize environmental disturbance and avoid risks of damage to one line while constructing the other. This would also reduce construction costs.

FIGURE 9

INITIAL DEVELOPMENT PLAN (OFFSHORE) SANTA YNEZ UNIT



On May 3, 1974, as a prerequisite to approval to the development plan, the Department of Interior published its Final Environmental Impact Statement on the Santa Ynez Unit which analyzed the impacts of both Exxon development plans. In this document, a 140-mile crude oil pipeline from Las Flores to Los Angeles was analyzed as an alternative method of transporting the crude to the refinery. The report found the pipeline alternative offered no significant environmental advantages and was economically inferior to the marine terminal and barging alternative in Exxon's onshore plan. (See figure 10.)

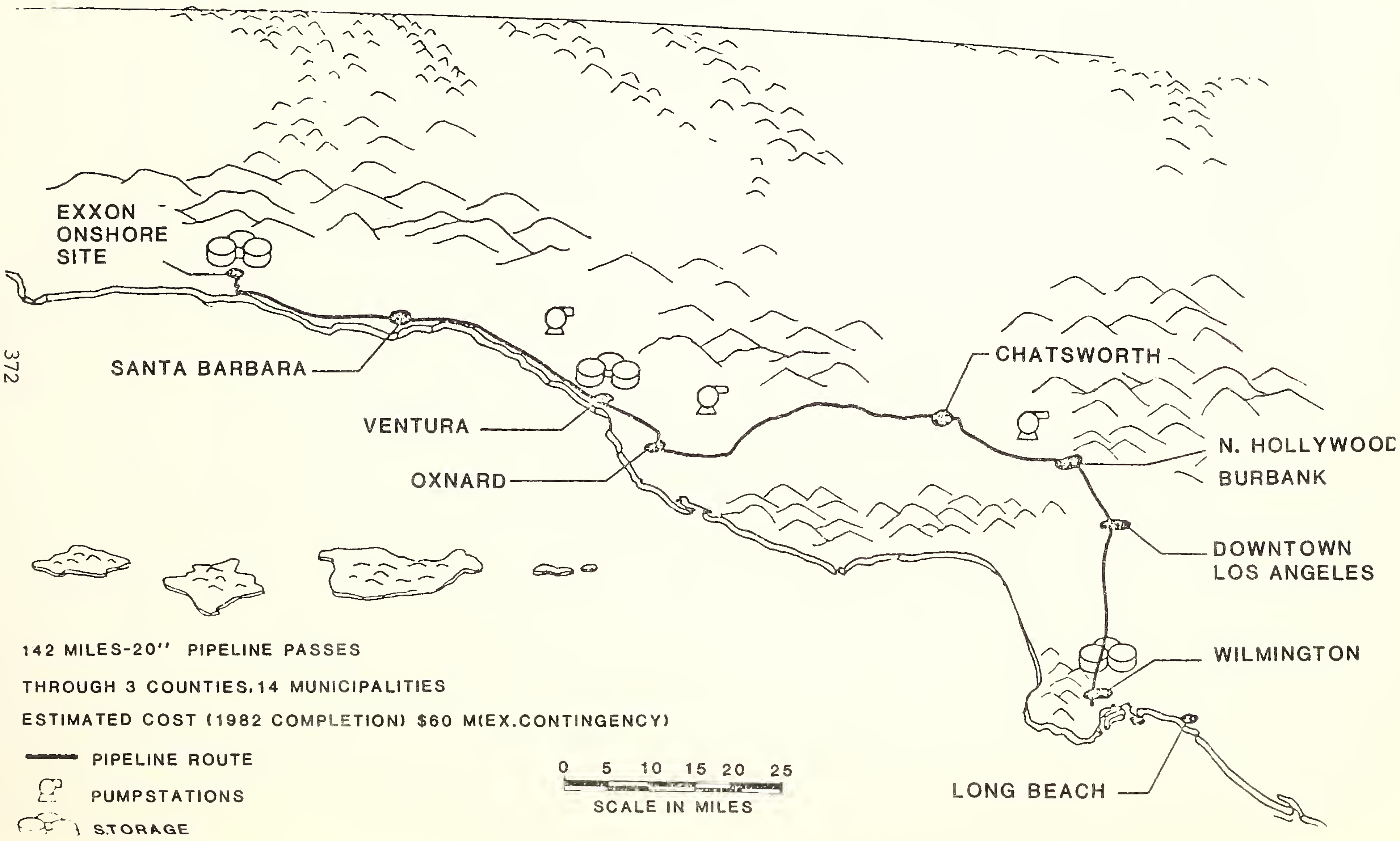
The possibility of an onshore pipeline had been considered by Exxon as early as 1971. Humble Pipeline Company (a division of Exxon Company, USA), had completed an in-house study of a possible onshore pipeline from Las Flores to Los Angeles. They rejected this alternative because of its higher cost. In 1975, Exxon estimated the cost of the onshore pipeline at about $55 million, the marine terminal using a single anchor leg mooring at $7 million, and the offshore alternative of two offshore storage and transfer units to handle the anticipated peak production at $58 million.

On October 21, 1974 the Santa Barbara County Planning Commission published its Final Environmental Impact Report preparatory to approval of Exxon's rezoning application for its onshore facilities. This approval was given on December 18, 1974. On December 19, 1974 the State Lands Commission approved Exxon's proposed marine terminal with one condition. Efforts in 1975 by a newly constituted State Lands Commission to reopen the lease question were enjoined. On December 31, 1974 the FPC published its draft Environmental Impact Statement for the gas pipeline. It recommended 27 conditions to approval.

On February 10, 1975 the Santa Barbara County Board of

FIGURE 10

POSSIBLE CRUDE PIPELINE ROUTE



142 MILES-20'' PIPELINE PASSES

THROUGH 3 COUNTIES, 14 MUNICIPALITIES

ESTIMATED COST (1982 COMPLETION) $60 M(EX.CONTINGENCY)

Supervisors adopted a rezoning ordinance (approved earlier by the Planning Commission) and approved the Use Permits for the Las Flores Canyon onshore separation treatment facility, subject to 73 conditions. The Board was divided three to two, and both OPR and the Energy Commission took pains in their respective reports to point out that the deciding votes were cast by Supervisors aware that if the onshore facility were denied, Exxon would pursue the Offshore Alternative.

On May 27, 1975, a referendum was held in Santa Barbara County on a proposal to nullify the rezoning ordinance for the Las Flores Canyon facility. The ordinance was narrowly upheld. State officials reported that Exxon heavily outspent its opponents.

In June, 1975, the Department of Interior published a Draft Environmental Impact Statement (DEIS) entitled Oil and Gas Development in the Santa Barbara Channel Outer Continental Shelf Off California. This document examined the potential impacts and planning problems of operation throughout the Channel, including those posed by the Santa Ynez Unit development.

On September 11, 1975, the South Central Regional Coastal Commission approved a coastal permit for the Exxon facilities located within the coastal permit zone, subject to a list of conditions. This permit covered underwater and underground pipelines, utilities, an improved access road, a modified and improved marine oil terminal, and an electric substation. One of the conditions for this permit would commit Exxon to building a 20-inch crude oil pipeline from Las Flores to the Los Angeles refining area if such a pipeline were determined economically feasible by the Coastal Commission or its successor. Exxon would be required to operate the pipelines as a common carrier facility available to all producers who would be bringing oil ashore from other OCS leases off Southern California.

Exxon objected to the pipeline on numerous grounds, among which were:

- The estimated four-year delay (from late 1977 to 1981) in oil and gas production that would result from the time required to design the pipeline, prepare an EIR, obtain administrative approvals, and construct;
- Exxon's present inability to accurately assess the economic acceptability of the onshore pipeline, given the lack of complete information about the size of the Santa Ynez offshore resource, and Exxon's inability to determine the degree of participation by other companies in the common carrier pipeline;
- Exxon's firm insistence that the decision, and the proprietary information on which to base the decision, regarding economic acceptability of the onshore pipeline alternative must remain exclusively within the Exxon boardroom, and must not be left to any public agencies; and
- The state could not guarantee secure transportation for the Santa Ynez crude to refineries even if Exxon demonstrated good faith efforts over the succeeding two years to obtain prerequisite approvals for the pipeline from all the necessary agencies.

Exxon appealed the South Central Coast Regional Commission's decision to the California Coastal Zone Conservation Commission (CCZCC), Appeal No. 216-75.

During October and November, 1975, the State Commission staff reviewed the Exxon appeal. The staff decided that use of a common carrier onshore pipeline to transport Exxon's Santa Ynez crude and the crude oil production of other companies operating in the Channel could eliminate marine oil terminal oil spill risks, vessel traffic safety concerns, air emissions from tanker loading, and the need for other terminals in the Channel. The staff also decided that an onshore pipeline from Las Flores Canyon to the Los Angeles/ Long Beach refinering area was "technically and economically feasible, and that environmental disruption would occur only in the construction phase."

In discussions during these months, Exxon contended that delays and technical problems would render the onshore pipeline alternative infeasible. "The transportation facilities ... must be available and operative by October of 1977, when oil production is scheduled to commence from the platform. No other oil transportation system could be available within that time frame except the already approved offshore alternative."

The Coastal Commission staff agreed that oil and gas production from Santa Ynez ought not to be delayed until the onshore pipeline could be approved and constructed. Therefore, the staff agreed to recommend that Exxon be allowed to construct and operate the proposed marine terminal as an interim facility pending completion of the pipeline.

In discussions with Exxon, Commission staff found agreement with conditions regarding compliance with air quality standards and consolidation of facilities for treatment and shipment of Arco crude from Las Flores. Exxon was concerned, however, that the provisions for interm use of the marine terminal "could be the subject of future controversy, with Exxon conceivably being in the extreme situation of having been unable to complete a pipeline and yet having its marine terminal permit expiring."

Exxon offered to consider the pipeline as a possible alternative. Exxon offered to spend $300,000 for preliminary engineering studies of a pipeline and to provide an additional $200,000 for preparation of an EIR. Exxon agreed, if its studies indicated the pipeline to economically and environmentally sound, to begin the process of obtaining necessary approvals for the pipeline. Additionally, Exxon offered to contribute up to $40 million to a common-carrier pipeline that would be available to all producers in the area if 1) the company developed production in excess of 40,000 B/D, 2) necessary permits could be obtained, and 3) other industrial financing could be guaranteed. The $40 million limit applied to Hondo field only. If the other fields in the Santa Ynez Unit proved to be productive, Exxon's financial and volume commitment to a pipeline could increase.

Exxon's counterproposal, which would have given the company a permanent permit for onshore treatment facilities and offshore marine terminal limited to handling 40,000 barrels per day of production from Santa Ynez (plus an additional production sent by Arco to Las Flores for consolidated treatment and shipping at Las Flores), was unacceptable to the Commission staff. The Coastal commission staff recommended rejection of the alternative "because it could be, in effect, an incentive to Exxon to keep production at 40,000 barrels per day, a greater rate than any other facilities in the Santa Barbara Channel. Thus, there would be little incentive to build the environmentally-preferable pipeline". The December (1975) approval deadline was extended in the hopes of reaching an agreement.

Meanwhile, in November 1975, the Santa Barbara County Board of Supervisors had given final approval to Exxon's development plan.

Also, in November 1975, the FPC granted a "Phase I" certificate to construct, but not operate the gas line. The construction of oil and gas lines must be done simultaneously and was permitted only if Exxon, a) obtained the permits necessary for the oil line, and b) filed a gas sales contract (a normal prerequisite). In its application, Exxon stated that it might be a number of years "before any natural gas would be available for sale." Initial gas produced would be reinjected into the reservoir to boost oil production.

During the extended discussions between Exxon and the CCZCC staff, the CCZCC staff felt strongly that: "a) Exxon should remain under pressure to move forward diligently through the successive stages of pipeline design, EIR preparation, and permit approvals; (b) Exxon should at all times bear the burden of proof in any application for extension of the use of the marine terminal beyond the five-year period; and (c) all subsequent judgments as to impossibility, undesirability, or infeasibility, including economic infeasibility, should be made by a public agency, and not by Exxon. The Commission staff believed that while many compromises can indeed be justified by a broad interpretation of the Coastal Act, the Act at least demanded adherence to these points." (OCS Task Group of OPR, 1977).

The Commission staff proposed that the interim marine terminal be approved for a period of five years only. If Santa Ynez production never exceeded 40,000 B/D oil, use of the marine terminal would be allowed to continue indefinitely; and that Exxon be required to proceed with the pipeline on a prescribed schedule. Within six months of the end of the five-year period, Exxon would have to appear before the Commission or its successor and demonstrate justification for extended or permanent use of the marine terminal, or face shutdown of the terminal. For a determination as to the economic feasibility of the pipeline, Exxon would have to petition the California Public Utilies Commission.

Exxon rejected these proposals, primarily on two grounds. First, it objected to the idea that a public agency would retain discretionary authority to shut down its only means of transporting Santa Ynez crude at some future date. Second, Exxon insisted both on retaining the exclusive right as a private company to make decisions regarding economic feasibility of a development option and on the need to set actual dollar limits on its commitment to build a pipeline. Negotiations finally ceased during the last week of February, and the staff issued its recommendation that the Commission approve the Exxon project, subject to conditions Exxon had refused to accept.

On March 3, 1976, the Commission met to vote on the Commission staff recommendation that the Exxon development proposal be approved subject to rigorous conditions. Before the vote a telegram arrived from Under Secretary Frizzell. The telegram warned the Commission that should Exxon reject the conditions proposed, the Department of Interior would not withdraw its approval of the alternative offshore facility by reason of such rejection. The message was clear: If the Coastal Commission insisted on conditions Exxon could not accept, it would have to bear the responsibility for the increased environmental risks and the forfeiture of natural gas resulting from the Offshore Alternative.

The Commission voted ten to one to adopt the staff recommendation, with only minor changes. The Commission's clearly expressed concerns were (1) the need for a coordinated planning approach to petroleum development throughout the Santa Barbara Channel, starting with the Santa Ynez Unit; and (b) the need for ultimate decision-making authority to reside in the public sector.

The Department of the Interior's Final Environmental Statement on the Santa Barbara Channel Development, issued March 4, 1976, the day after the Coastal Commission action described above, confirmed the findings presented in the draft document, and in addition included a strong endorsement of the findings by the Western Oil and Gas Association. The report recommended that a Channel-wide strategy should be developed. This strategy should incorporate maximum consolidation of facilities onshore and offshore. The use of an onshore pipeline rather than tankers for transportation of crude oil to refinery markets would be the most environmentally strategic even though it was economically the least desirable strategy. The strategies were in accord with policies for petroleum-related development included in the Coastal Plan, presented to the Governor and the Legislature December 1, 1975.

Exxon filed suit against the Coastal Commission in Federal District Court in Los Angeles and the Superior Court of California in Santa Barbara, seeking an order setting aside the Commission's decision. Exxon's suit asserted that the Commission acted unlawfully in mandating construction of the 140-mile pipeline outside of its permit area, and in setting other conditions exceeding the Commission's authority under the Coastal Act. The suit also attacked the validity of the Commission's conditions extending five years beyond its own mandated existence.

On March 4, 1976, the Chairman of the Coastal Commission wrote to the Secretary of the Interior Kleppe, urging him to "rescind the Frizzell telegram and to give fair consideration to the reasonableness of the Commission's conditions." On April 9, Governor Brown seconded the Chairman's appeal, which had gone unanswered by the Secretary. The Department of the Interior subsequently commissioned a technical paper to compare the economic and environmental effects of all three alternatives --- the marine terminal, the offshore storage and transfer unit, and the land pipeline.

On March 3, 1976, when the Coastal Commission finally voted to approve the Exxon project subject to conditions unacceptable to the applicant, a further blow was struck to the ill-fated natural gas pipeline, when the Commission ordered that "the permission granted herein is to construct and operate oil and gas pipelines only as a unit; gas line without oil line is not allowed."

On May 3, 1976, the Department of the Interior circulated a report, "Analysis of Alternatives for Transport, Storage, and Treatment of Oil from the Santa Ynez Unit, Santa Barbara Channel" to a number of California state and local agencies for review and comment. The report examined the economics of three possible methods of transporting crude oil from the Santa Ynez Unit: Marine terminal, offshore storage and treatment vessel (Offshore Alternative), and onshore pipeline. The Department's "Technical Paper" concluded that:

- The marine terminal is preferable to either of the other two alternatives;
- The offshore terminal ranks second in preferability; and
- The onshore pipeline is the least preferable alternative.

The report considered high and low scenarios for environmental costs and also for the probability of oil spill occurrence. The decision was not found to be sensitive to these factors.

On July 21, 1976, Assistant Secretary of the Interior Ronald G. Coleman, wrote Coastal Commission Chairman Melvin B. Lane, and reaffirmed the Department of Interior's decision to approve Exxon's Offshore Alternative. Coleman's letter cited the need to eliminate regulatory uncertainty so that OCS oil could be produced "in a timely and efficient manner" and to strike a balance between environmental and economic goals. He based his finding that the Commission's permit conditions were unreasonable on the findings of the Department's technical analysis.

On July 21, 1976, the Department of the Interior announced the Secretary's final decision that the California conditions were unreasonable, reaffirming the Department's final approval of the offshore alternative. Exxon then decided not to pursue lawsuits it had filed challenging the state's position. The suits could have taken several years to prosecute. Instead, the company has decided to implement the Offshore Alternative. Meanwhile, on December 17, 1975, Exxon had asked the FPC for permission to construct the natural gas pipeline and associated treating facilities irrespective of which of the alternative proposals for oil transportation is ultimately utilized.

In its July 22, 1976 Order, the FPC denied Exxon's application for an amended Order to construct the gas pipeline independently of the crude oil pipeline and required that Exxon either amend its present request for certificate authorization, or file a new application, reflecting Exxon's currently contemplated project (the Offshore Alternative). The FPC Order also required that Exxon file a gas sales contract for the natural gas involved with its amended or new application. The FPC concluded that, on the basis of the certificate application, it did "not have a valid ground for certificating the construction of the gas pipeline alone at this time."

In October, 1977, the California Office of Planning and Research, OPR, published a two-volume, in-depth analysis of the OCS leasing program. The study concluded that no substantial, concentrated or permanent employment or population growth impacts would result from Lease Sale 35. However, activity resulting from offshore development was expected to have substantial adverse impacts on regional air quality, and to present a significant threat of oil spill damage to specific resource areas within the region.

The OPR study recommended changes in the OCS decision-making process, including:

- More timely and extensive participation in the OCS leasing process by state and local governments;

- Improved access to the basic OCS resource data and information essential for state and local planning purposes;
- Greater coordination of and cooperation among responsible federal, state, and local agencies and industry throughout the OCS leasing and impact planning process; and
- Improved provision for advance planning by state and local governments to confront the pressure of OCS development.

Subsequent to Lease Sale 35, a follow-on effort has been conducted by the OPR OCS Project team to help prepare local and state governments to deal with specific impacts potentially affecting southern California, alternatives that could mitigate some of these impacts, and recommendations for the necessary institutional arrangements required to achieve basic goals and objectives. The successor effort is also intended to respond directly to current and projected development plans in the Santa Barbara Channel, the actual areas leased in Lease Sale No. 35, and Lease Sale No. 48.

It is significant to note the implications of the Commissions insistance that they be given board-room decision power within an oil industry. First of all, if the Commission was dealing in good faith to obtain its stated goals, the Commission must have assigned some probability greater than zero to the likelihood that Exxon would accept such a condition. On the other hand, if the Commission knew full well that the industry would not accept such a stipulation, then why would it insist on such a stipulation? It may have considered it a delaying tactic, but more probably it thought it had a trump available. That trump might have been the EPA.

Simultaneous to the events described above, EPA was conducting discussions on the air quality impacts that the OCS oil and gas development would have on the adjacent onshore air basins. All of the adjacent air basins have been declared non-attainment areas and additional pollution sources would complicate efforts to reduce air pollution in such areas.

EPA has determined that the installation of Exxon's offshore storage and treatment (OS&T) facility is subject to preconstruction review under EPA's new source review and prevention of significant deterioration regualtions. Pursuant to the provisions of those regulations, Exxon Corporation must obtain the approval of the Administrator, prior to the commencement of on-site construction of the OS&T. Commencement of on-site construction of the OS&T without such approval will be a violation of the Clean Air Act and may subject Exxon Corporation to enforcement pursuant to section 113 of the Act. (42 U.S.C, para. 7413). Exxon may, however, continue with off-site fabrication of the OS&T prior to receiving approval to construct from EPA.

EPA's initial estimates of air pollutant emissions from Exxon's platform Hondo and the proposed associated offshore oil storage and treating facility (OS&T) were based on information supplied by Exxon in a letter dated October 1, 1976. Subsequently, Exxon submitted additional information on several occasions to either replace or supplement information in its original submittal. This subsequent information has been considered in EPA's updated emission estimates.

Emission sources located on Exxon's platform Hondo can be classified into three general categories, based on the frequency at which they can be expected to emit pollutants: 1) continuous, 2) intermittent, or 3) unscheduled. For the initial level of Hondo development (30,000 BBL/D oil, 30 MM CF/D natural gas) continuous sources will include three

800 KW gas fired turbine generators, one 1.0 MM BTU/hr gas fired stack pilot and fugitive hydrocarbon sources including hydrocarbon pumps and valves and 3-200 BBL fixed roof diesel storage tanks. Intermittent sources of emissions include two emergency firewater pumps, each of which will be operated approximately fifteen minutes per week for test purposes, tank filling emissions from the diesel storage tanks and two diesel engine crane engines. Unscheduled emissions, which were not considered in EPA's emission estimates would occur from the flare stack as a result of a compressor malfunction. Information regarding additional emission sources on the platform for peak Hondo production (60,000 BBL/D oil, 60 MM CF/D gas) and the resultant emissions has not been submitted to EPA.

Exxon submitted estimates of annual average emissions from initial phase production at platform Hondo in their October 1, 1976 letter to EPA. Assuming the emission rates listed above, Exxon's platform Hondo by itself would not be considered a "major source" (7100 T/yr) as defined by EPA's Interpretative Ruling.

Emission sources associated with the proposed OS&T can also be classified as continuous, intermittent or unscheduled. Continuous emission sources on the proposed OS&T include two 25,000 HP gas-fired turbines, the acid gas incinerator, a 1.0 MM BTU/hr gas fired flare stack pilot and fugitive leaks of hydrocarbons. Intermittent sources include a 800 KW auxiliary generator, fired by a 1100 HP diesel fired turbine and two 200 HP diesel driven emergency firewater pumps to run once a week to insure operability and operation and loading of the crude oil shuttle tanker. Estimated emissions from the operation of the OS&T at a production rate of 30,000 bbl/day are listed in Table 4 while estimated emissions at a production rate of 60,000 bbl/day are listed in Table 5.

The data listed in Tables 4 and 5 establishes that the operation of the OS&T will result in emissions greater than 100 tons per year for nitrogen oxides, sulfur oxides and hydrocarbons. The OS&T will thus be a "major source" for those pollutants for purposes of new source review. Since emissions of those pollutants will be greater than 250 tons per year, the OS&T will also be a major emitting facility for purposes of prevention of significant deterioration.

On January 20, Exxon presented information on a vapor balance system which is being studied by EPA as a possible means of controlling hydrocarbon emission during loading of the shuttle tanker and which would purportedly significantly reduce SO2 emissions from the acid gas incenerator. The impact of such a system has not been considered in EPA's estimates of emissions because Exxon has stated that the balance line has not been fully developed. It is not known, therefore, whether Exxon will be able to install the vapor balance system in the future. It is clear, however, that the vapor system will not be installed until after the OS&T has begun operation.

Although the Clean Air Act is not expressly applicable to facilities located on the Outer Continental Shelf, EPA has determined that the new source review and prevention of significant deterioration provisions of the Clean Air Act are applicable to sources located on the Outer Continental Shelf. This determination was made pursuant to the Outer Continental Shelf Lands Act, 42 U.S.C., 1331, et seq. Section 1333(a)(1), of the OCS Lands Act provides that the laws of the United States are applicable to fixed structures located on the Outer Continental Shelf:

> The Constitution and laws and civil and political jurisdiction of the United States are extended to the subsoil and seabed of the Outer Continental Shelf and to all artificial islands and fixed structures which may be erected thereon for the purpose of exploring for, developing, removing, and transporting resources,

Table 4

Atmospheric Emissions from Exxon OS&T (30,000 bbl/day)
(from data supplied by Exxon) in lb/hr (tons/yr)

Continuous Emissions	NOx	Hydro-carbons	CO	Partic-ulates	SOx
Acid Gas Incinerator	.6 (2.6)				247 (1080)
25,000 HP Turbine Generator	93 (407)	12.3 (54)	61.6 (270)	.53 (2.3)	1.8 (7.8)
Flare Stack Pilot	.1 (.42)	.006 (.028)	.016 (.069)	.011 (.050	.011 (.047)
Total Continuous Emissions	94 (410)	12.3 (54)	61.6 (270)	.54 (2.35)	249 (1088)
Intermittent Emissions					
Shuttle Vessel	46 (5.9)	1483 (323)	19 (2.4)		4.9 (.62)
Acid Gas Incinerator	.78 (.17)				320 (70)
800 KW Generator	4.6 (.12)	.38 (.01)	1.1 (.027)	.35 (.01)	3.6 (.094)
Firewater	3.1 (.08)	.25 (.006)	.67 (.017)	.22 (.0057)	.20 (.0053)
Maximum Hourly Emission	148	1496	82	1.1	579
Annual Emissions	(416)	(377)	(272)	(2.37)	(1159)

Table 5.

Atmospheric Emissions from Exxon OS&T (60,000 bbl/day
in lb/hr (ton/Yr))

Continuous Emissions	NOx	Hydro-carbons	CO	Partic-ulates	SOx
Acid Gas Incinerator	1.2 (5.2)				365 (1600)
25,000 HP Turbine Generator	110 (482)	2.34 (10.2)	11.7 (51.2)	.7 (3.1)	2.4 (10.3)
Flare Stack Pilot	.1 (.42)	.006 (.028)	.016 (.069)	.011 (.050	.011 (.047)
Total Continuous Emissions	111 (488)	2.35 (10.2)	11.7 (51.3)	.71 (3.2)	367 (1610)
Intermittent Emissions					
Shuttle Vessel	46 (11.8)	1483 (646)	19 (4.8)		4.9 (1.24)
Acid Gas Incinerator	.78 (.34)				320 (140)
800 KW Generator	4.6 (.12)	.38 (.01)	1.1 (.027)	.35 (.01)	3.6 (.094)
Firewater Pump	3.1 (.08)	.25 (.006)	.67 (.017	.22 (.0057)	.20 (.0053)
Maximum Hourly Emission	165	1486	32.5	1.3	696
Annual Emission	(500)	(656)	(56.1)	(3.2)	(1751)

> therefrom, to the same extent as if the outer Continental Shelf were an area of exclusive Federal jurisdiction located within a State: Provided, however, that mineral leases on the outer Continental Shelf shall be maintained or issued only under the provisions of this subchapter.

EPA contends that the Clean Air Act is a law of the United States within the meaning of the OCS Lands Act. Although the OCS Lands Act was enacted several years before the Clean Air Act, the legislative history of the OCS Lands Act reveals that Congress intended to extend the whole law of the United States to the seabed of the OCS and fixed structures located thereon.

In addition, section 1333(a)(2) of the OCS Lands Act provides that to the extent that they are applicable, state laws are also extended to fixed structures located on the Outer Continental Shelf as long as the state law is not inconsistent with federal law:

> To the extent that they are applicable and not inconsistent with this subchapter or with other federal laws and regulations of the Secretary now in effect or hereafter adopted, the civil and criminal laws of each adjacent state, now in effect or hereafter adopted, amended, or repealed are declared to be the law of the United States for that portion of the subsoil and seabed of the outer Continental Shelf, and artificial islands and fixed structures erected thereon, which would be within the area of the State if its boundaries were extended seaward to the outer margin of the outer Continental Shelf, and the President shall determine and publish in the Federal Register such projected lines extending seaward and defining each such area. All of such applicable laws shall be administered and enforced by the appropriate officers and courts of the United States. State taxation laws shall not apply to the outer Continental Shelf.

EPA has determined, moreover, that application of the applicable state implementation plan to exploration and production facilities located on the Outer Continental Shelf is necessary to assure that national ambient air quality standards can be achieved in those areas presently classified as nonattainment areas. Unless regulated, emissions of air pollutants from sources located on the Outer Continental Shelf will adversely impact air quality in such areas by adding additional pollutants to areas where air quality is presently worse than national ambient air quality standards. This problem is particularly severe with respect to emissions of hydrocarbons which are the precursors of photochemical oxidants.

Since EPA believes that emissions from Exxon's operations in the Santa Barbara channel will have an adverse impact upon air quality within Santa Barbara, Ventura, and Los Angeles counties, EPA has determined that the new source review and prevention of significant deterioration provisions of the California State Implementation Plan should be applied to Exxon's facilities. Since EPA has not yet approved new source review rules or regulations for prevention of significant deterioration for Santa Barbara or Ventura Air Pollution Control Districts, EPA has determined that the new source review and PSD regulations promulgated by EPA for those districts are applicable to Exxon's operations on the Outer Continental Shelf.

Exxon has pointed out in its comments to EPA that EPA has never previously asserted jurisdiction under the Clean Air Act with respect to facilities located on the Outer Continental Shelf despite the fact that hundreds of exploration and production platforms are located on the OCS. EPA contends it has not asserted jurisdiction in the past over facilities located on the OCS because of uncertainty regarding its authority to subject such facilities to regulation under the Clean Air Act. EPA has subsequently determined that the provisions of the Clean Air Act are applicable to facilities located on the OCS by virtue of section 1333(a) of the OCS Lands Act.

In addition, EPA has determined that it is necessary to assert jurisdiction at this time over platform Hondo and the proposed OS&T because it is anticipated that Exxon's operation of the OS&T will have a significant impact upon air quality in Santa Barbara, Ventura and Los Angeles counties. Since those areas are presently classified as non-attainment areas for several pollutants, EPA determined that emissions from Exxon's operations should be regulated in order to prevent further deterioration of air quality in those areas despite the fact that EPA has not previously asserted jurisdiction under the Clean Air Act over facilities located on the OCS.

Appendix A.

The attitudes of the people involved in the oil and gas development of the southern California OCS ranges from those with faith in the capitalist system, who believe that existing legislation is adequate, to those who believe that strong government control must be imposed to insure the development is carried out to the optimum benefit of all. The dividing line between these two camps is not always clear and some parties have been known to switch sides. The first group is composed chiefly of those people who have brought oil and gas development to its present stage. These people have displayed great flexibility in the face of change and they are obviously proud of what they have developed so far. They are confident they can meet any challenges that will arise in the future. The principal interests in this camp include the largest oil and gas companies in the world and the government agencies with which they have dealt for years.

The other camp is a loose coalition of those people who are not satisfied with the present situation and consider their opponents in this controversy as the villians who have created the situation. They believe that the present pollution situation is intolerable and that further oil and gas development must be strictly controlled lest it makes the situation worse. They also see an opportunity in this situation to create a model for the solution of similar problems in the future. These people are trying to wean California from the non-renewable energy resources that are quickly becoming scarce. The Californians who are implementing this philosophy see themselves as the leaders of this country and the world in the conservation field.

The "offset policy" was developed by these conservationists to insure that they could halve increasing pollution and start to decrease it. The offset policy forces trade-offs of like kinds and quantities. Under this policy a new source industry must correct existing industry pollution effluents in order that its effluents do not result in a net increase of any pollutant. The corrected pollution source must be matched in type to the new source pollution. The corrective measure must surpass in quantity the new source so there is, in fact, a net gain in environmental quality.

Other participants in the management of the OCS are:

- Department of the Interior

The functions and activities of the Department of the Interior's Bureau of Land Management and its U.S. Geological Survey are covered in substantial detail in a Geological Survey Circular 720 entitled, "Mineral Resource Management of the Outer Continental Shelf."

- U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers administers a permit program that regulates activities in navigable waters in accordance with 33 CFR Parts 320 and 329 (July 19, 1927). Permits for three kinds of activities might be required by the oil developers of the OCS.

1. Under Section 10 of the Rivers and Harbors Act of 1899, a permit is required for all structures or work in or affecting navigable waters of the United States except for
   a) bridges and causeways which are under Coast Guard jurisdiction
   b) structures or work licensed under the Federal Power Act of 1920.

Navigable waters are those waters subject to the ebb and flow of the tide shoreward to the mean higher high water mark on the Pacific coast.

2. A permit is required for the discharge of dredge or fill materials into waters of the U.S. under section 404 of the Federal Water Pollution Control Act amendments of 1972. Waters of the U.S. include the territorial seas, navigable waters of the U.S., tributaries to navigable waters of the U.S. and their adjacent wetlands, and all other waters of the United States, the degradation or destruction of which could affect interstate commerce. The landward limit of jurisdiction in tidal waters is the ordinary high water line in the absence of wetlands.
3. A permit is required for the transportation of dredged materials destined for dumping in ocean waters under Section 103 of the Marine Protection

> Research and Sanctuaries Act of 1972. The Environmental Protection Agency requires a separate permit for the same activity under section 102 of the same Act. These are two separate legislative requirements administered jointly by the Corps and EPA.

The processing of these three Corps of Engineer permits is similar. Permit applications are submitted to the local Corps District Office. Review, evaluation and acceptance of the application takes two weeks normally. Another two weeks is spent making a preliminary environmental assessment. The application is then advertised for 30 days by public notice. A copy is sent to all responsible government agencies, navigation and environmental interests, newspapers and the adjacent property owners. Comments on all three permits are required from the Environmental Protection Agency, the National Oceanic Atmospheric Administration, U.S. Fish and Wildlife Service, and affected state and local government agencies.

The state must certify that the proposed work complies with the applicable provisions of Section 301 (effluent limitations), Section 302 (water quality limitations), Section 306 (national water performance standards), and Section 307 (toxic and pretreatment effluent standards) of the Federal Water Pollution Control Act. A public hearing may be held. The applicant is responsible for resolving any objections arising during the review or the public hearing.

If the applicant is unable to resolve the objections, he may request that the application be processed over the unresolved objections. If the objection is from a federal agency, the application must be forwarded to higher authority for final determination. If the state or local government objects to an application, the Corps of Engineers will usually deny a permit. If an Environmental Impact Statement is determined appropriate, the District Engineer will consider the probable effects of the proposed work on navigation, fish and wild life, water quality, energy needs, etc. The final EIS may take nine months to two years to prepare and file with CEQ.

The District Engineer spends the next month preparing a "finding of fact." After this, the District Engineer decides whether the proposed work is in the public interest. If so, a permit is issued. U.S. Army Corps of Engineer permits can take from three months to three years to process.

Environmental Protection Agency

Under the August 7, 1977 amendments to the Clean Air Act (42 USCS7401 et seq.) EPA conducts two permit type activities related to air emissions: 1) the Prevention of Significant Deterioration of the Air (PSD), and 2) compliance with New Source Performance Standards. EPA also provides guidelines for Oil Spill Prevention Control Plans.

A PSD approval is required for construction or modification of petroleum refineries or petroleum storage and transfer facilities (such as the Santa Ynez Unit Hondo platform) with a capacity exceeding 300,000 barrels per day or the potential to emit over 100 tons per year of any air pollutant under EPA's implementing regulations (40 CFR 51 & 52). Any associated facility with the potential to emit more than 250 tons per year of any air pollutant would also require this approval. This approval is required before construction or modification. Approval under EPA implementing regulations will be granted if three conditions are satisfied.

1. The proposed facility will not violate air quality increment areas defined in the State Implementation Plan.
2. The proposed facility will meet new source performance standards for the industry or, if these have not been issued, the best available air emission control technology.
3. The National Ambient Air quality standards are not violated.

Under Federal guide lines a state must classify all state lands into one of:

Class I - pristine area with stringent standards
Class II - a middle standard applied to most areas of a state
Class III - non attainment areas largely for existing industrial areas.

All large national parks have been given mandatory Class I designations for PSD purposes. Section 165 of the Clean Air Act, as amended, however, allows federal land managers or state governors to allow emissions to exceed the Class I standards almost to the Class II level when an owner or operator of a new source of air emissions can demonstrate satisfactorily that the emissions will have no adverse impact on the air quality-related values.

Several of the Channel Islands are sanctuaries so this flexibility will be an important consideration for OCS development off southern California.

The approval process for a completed PSD application involves the following steps:

- Within 20 days of receipt of an application, EPA must notify applicant of any deficiencies.
- Within 30 days of receipt of a completed application, EPA issues a preliminary approval or disapproval.
- A public notice is issued. If sufficient interest is generated public hearings are held. Public comment period lasts 30 days.
- Applicant has 10 days to respond to public comments.
- Within 30 days after public comment period EPA must give final approval or disapproval.

The review typically takes 90 to 120 days although the Clean Air Act, as amended, allows EPA a year to take action.

Construction or modification must be initiated within 18 months after final PSD notification. There is no expiration date for PSD approval for facilities once they are constructed. There are no fees involved in the application process. EPA can obtain a court injunction to prevent construction or modification for any project which does not have PSD approval.

New Source Performance Standards

There are no fees associated with this program.

Within 60 days of achieving maximum emissions and within 180 days of a facility start-up, a source test must be conducted. The new source performance standards contain guide lines for conducting this source test. The EPA must be notified of a source test at least 30 days in advance so agency representatives can, if they desire, observe the test.

The PSD approval requires a regular system of emission monitoring which can be used to determine if new source performance standards for emissions are being complied with over time. EPA and state officials review the data and verify with their own sampling.

Offset Policy Administered by the State

A proposed facility which will emit more than 100 tons of a pollutant per year, that is located in or close to a non-attainment area, may be required to seek offsets to its proposed emissions to receive approval from EPA. Offsets are allowed only if all the following conditions are met:

1. The new source will meet emission standards which are the lowest achievable for such a source.

2. The proposed source's emissions will be offset by reducing other emissions in the area of the proposed source such that the offset will provide a positive net air quality benefit in the affected area.

3. The emission offset must be on a like for like basis.

4. Construction will not commence prior to EPA approval. This requirement was waived for the Hondo's platform because construction started before EPA served notice.

- Joint EPA - USCG

Section 311 of the Federal Water Pollution Control Act provides the Coast Guard and the Environmental Protection Agency with on-scene authority for removal of spilled oil. Section 311 requires:

1. The operator of any vessel or facility causing an oil spill in harmful quantities immediately notify the U.S. Coast Guard. Failure to report is a crimunal offense punishable by fine and imprisonment.

2. The U.S. Coast Guard assumes responsibility for cleanup of the oil whenever it is not done satisfactorily by the spiller and may recover its costs from the polluter in court.

3. A national contingency plan for removal of oil and hazardous substances which includes the establishment of Strike Forces and surveillance systems for oil cleanup and provisions for reimbursement for costs.

4. The owner or operator of the facility that causes a spill is liable for costs incurred by the governemnt during cleanup operations including replacement of natural resources destroyed. If natural resources cannot be restored, the cost of acquisition of natural resources to offset those lost must be met by the polluter.

5. Issue regulations establishing standards for equipment and procedures for the prevention, containment, and removal of spills from vessels and facilities.

6. Inspect vessels and facilities to insure compliance with standards and reduce the likelihood of spills. Establish penalties for violations.

7. Establish a revolving fund of $50 million to pay for cleanup costs, research and administration.

8. Owners and operators of vessels over 300 tons must maintain evidence of financial ability to meet cleanup costs.

Appendix B.

Oil spills have three important economic consequences which have established liability limits.

The cost of the oil lost in a spill has always been considered the responsibility of the owner of the oil and the owner of the facility from which the spill originated. It is usually insured against loss.

Cleanup costs are the responsibility of the polluter; however, the liability is limited. The 1977 amendments to the Federal Water Pollution Control Act establishes liability limits for operators in the navigable waters of the United States.

Pollution Source	Liability Limits
Inland barges	$125/gross ton or $125,000
Other vessels	$150/gross ton or $250,000
Transfer & storage facilities	$50 million
Gross negligence	No limit

Owners are required to maintain evidence of their financial ability to pay.

Liability for oil spills on the high seas are not covered by U.S. law. Two international agreements, neither of which have been ratified by the United States, do establish liability. The International Convention on Civil Liability for Oil Pollution Damage (1969) sets the liability for tankers at $144 per gross ton or $15 million. The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1971) consists of contributions from cargo owners to cover acts of God in excess of the limits of the Civil Liabilities Convention up to $30 million to aid tanker owners financially incapable of meeting their liabilities. In addition to cleanup costs, these conventions cover private damage claims also.

Two non-governmental agreements cover liabilities for oil pollution. TOVALOP, the Tanker Owner Voluntary Agreement Concerning Liabilities for Oil Pollution, reimburses national and local governments for cleanup costs, but does not cover environmental damage. Most of the world's tanker tonnage is covered by TOVALOP CRISTAL, Contract Regarding an Interim Supplement to Tanker Liability for Oil Pollution is a fund established by cargo owners and oil companies for cleanup liabilities not covered by TOVALOP. It covers environmental damages.

	Liability Limits
TOVALOP	$100/gross ton or $10 million
CRISTAL	$125/gross ton or $30 million

Environmental damages from oil spills are problematic under general tort theory in the United States courts. The Trans-Alaskan Pipeline Act (43 USC 1651) establishes vessel liability limits for oil from the pipeline at $14 million per incident. Claims beyond this sum up to $100 million are paid from the Trans-Alaska Pipeline Liability Fund maintained by a levy of five cents per barrel of pipeline oil loaded on tankers for shipment to United States ports. The Act establishes a standard method of assessing environmental costs.

The Federal Water Pollution Control Act, 1972 amendments, subsection (f)4 and 5, establish governmental expenses in connection with damage to or destruction of natural resources at the cost of removal to be reimbursed from the owners and operators of the spill sources. For those resources which can be restored or rehabilitated, liability is the reasonable cost actually incurred by government in replacing the resources or mitigating the damage. When the damaged or destroyed resource is irreplaceable the measure of liability is the reasonable cost of acquiring resources to offset the loss.

The Oil Pollution Liability and Compensation Act (H.R. 6803) combines all of these divergent laws into a comprehensive scheme of liability and compensation for damages caused by oil pollution in the navigable waters of the U.S., the contiguous zone, or the high seas. This legislation establishes strict liabilities for the owners and operators of oil discharge sources and creates a backup compensation fund to cover damage claims which are not satisfied by the party responsible. The fund would be maintained between $150 and $200 million.

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